CURRENT SCIENCE

Vol. VIII] October 1939 [No. 10

The Mettur Dam Fisheries

THE Cauvery Irrigation System dates from time immemorial. Improvements to the system under the British rule date from 1801 when the *East India Company* took over the Tanjore District: reforms on modern lines may be stated to have commenced from 1836 when Sir Arthur Cotton, the father of most of the irrigation systems of South India, built the upper anicut. Further improvements followed which rendered the distribution of water when available in the river complete. But there still remained the problem of fluctuating supplies and long periods of drought. The solution was a storage reservoir and the Stanley Reservoir was finally decided on in 1910. The construction of the Mettur Dam, the second largest in the world, was commenced in 1925 and completed in 1934. The lake comprises a thirty-three mile length of the river and has an area of sixty square miles. It holds 93,500 million c. ft. of water and is expected to irrigate no less than 1,352,000 acres.

Unfortunately the effect of the Dam on the fisheries of the river below was disastrous. The number of valuable Indian Shad or Hilsa, the most important sea-fish ascending the Cauvery for breeding purposes, has seriously declined as the high floods which enabled them to ascend the river no longer occur. The heavy scores and the consequent deep pools all along the river caused by natural floods are gradually disappearing and the breeding fish of all kinds which sheltered in them are gradually

decreasing in number. The serious decline of the fisheries of the Cauvery will be evident from the fact that the fishery rentals of the river below the Dam in the Salem, Coimbatore, Trichinopoly, Tanjore and South Arcot Districts which used to amount to over 80,000 rupees annually has steadily declined since the formation of the Dam to about 42,900 rupees. When these fisheries which used to be under the control of the respective District Boards were taken over by the Fisheries Department for scientific organisation and development two decades ago, the average annual rentals used to be only about Rs. 41,000 which was paid as compensation every year to the five District Boards concerned.

The benefits of scientific control and culture which rapidly increased the rentals of the Cauvery by over 100 per cent., *viz.*, from Rs. 41,000 to Rs. 83,000 in the course of the first fifteen years have been undermined by the formation of the Mettur Dam. Serious efforts were therefore made to plan the development of the fisheries of the Mettur Reservoir to its maximum capacity.

A fish farm, a hatchery and an appropriate technical staff were sanctioned by Government in 1936. The farm and the hatchery are under construction. But a close study of the fisheries, their improvement by the formation of sanctuaries such as a four-mile reach immediately below the Hoginkal falls, and the Ellis surplus and other outlet channels to prevent undue destruction of fish, the complete prohibition of fishing in the lake in spite of ignorant opposition, the stocking of the Reservoir with new and improved varieties of food-fish, have all contributed during the last five years to a marked improvement of the fisheries of the lake and are paving the way to a resuscitation of the fisheries of the Cauvery. As the lake now holds a large number of food-fish, not the least important of which is the newly introduced North Indian carp, catla, which attains to hundreds of pounds in weight and is the most prized of the carps in the lake, it was decided to commence the exploitation of the lake from this year.

If the problems of development necessitated by the formation of the Reservoir are complex and difficult, equally so are those of judicious exploitation. From time immemorial our inland fishermen have never fished deep and perennial lakes. Their methods and implements are poor and suited only for fishing shallow or transient waters, especially when the rivers and tanks dry up in the hot weather. If a lake with a capacity of 93,500 million cubic feet and a depth of 165 feet is to be fished to maximum advantage, all known methods of fishing deep waters have to be introduced by the Department by demonstration and the nets perhaps even supplied by subvention. It is hoped that the Co-operative Society which has just been formed will form the nucleus of a scientifically organised agency for the fishing and marketing of the produce of the lake.

To prevent the advent of large capitalists who are apt to monopolise the profits to the detriment of the actual workers, it has been decided to license coracles and tackle and not to auction the fishery.

The system of licensing will, it is hoped, enable a closer control of these new and great fisheries in the early years, help the Department in educating the fishermen individually and through the medium of Co-operative Societies in improved methods of

fishing and wean them from the clutches of middlemen. In fact, no other method suggests itself if this new and valuable fishery is to confer lasting benefit on both the producers, the Government and the fishermen on the one hand, and the large body of the fish-eating public on the other hand. As the fish-population of the lake increases with scientific care and control and as the catches increase with improved methods of exploitation, an ever-increasing circle of markets for miles around the lake will receive an unfailing and abundant supply of fresh food-fish now practically unknown.

B. SUNDARA RAJ.

The Journal of the Indian Anthropological Institute

WE offer our hearty welcome to this new *Journal* which meets a long-felt want in this country. While the scope for Anthropology is very vast in India, anthropological studies are still in their infancy, and periodicals for the publication of specialist information have been scarce. The new *Journal* therefore provides a much needed forum for Indian anthropologists, and as the official organ of the Indian Anthropological Institute, its position is unique and authoritative.

In the Foreword to the first volume the editor, Dr. B. S. Guha, who is also the Secretary of the Indian Anthropological Institute, explains the objects of the Institute and the *Journal*. While the importance of anthropology among the various social sciences is being realised in an increasing measure by all men interested in the social relations of sciences, and every enlightened savant recognises anthropology as the starting point in all considerations of sociological problems, systematic study of anthropology in India has, according to Dr. Guha, suffered a set-back since the Government of India and the various Provincial Governments discontinued the work of the Ethnographic Survey. Recently, there has been a resurrection of the old interest, especially in university circles, the Universities of Calcutta, Bombay and Lucknow having included courses in anthropology in their curricula. (Incidentally, Madras is the only one among the three oldest Universities that has been merely contemplating a department for anthropology for over a decade without any tangible result.)

The leading article of the issue is the Presidential Address to the Institute by Prof. J. H. Hutton, Head of the Department of Archæology and Anthropology in the Cambridge University. After recounting the difficulties in the way of organising anthropological work in India Dr. Hutton says: "....These very difficulties that beset your work in themselves render it all the more imperative that you should undertake it, for I believe that the science of Anthropology can do more than any other branch of study to resolve into a homogeneous unit the racial, cultural and temperamental diversities inevitable in the inhabitants of so great an area and such varying environments."

As urgent problems calling for investigation, Dr. Hutton suggests (1) the linguistic survey of the region south of the Godavari; (2) the study of the effect of climate, diet, etc., on the human subject; (3) an examination of the validity of the belief in inherited aptitude (India with her caste system is a unique field for this piece of research, but the study ought to be undertaken before the caste system is too much weakened); and (4) the correlation of palæolithic chronologies. Dr. Hutton makes a passionate appeal for the preservation in museums of the mass of ethnographic material while they are still available for collection. "Men trained in

museum technique," he says, "are badly needed for this purpose, but like so many other requirements can be had only if funds for their training can be found. A regular campaign is needed to persuade the wealthy to give freely for the purpose of ensuring that the rich inheritance of this generation from the past shall not perish in India for want of men trained to preserve it".

The second article on "Pre- and Proto-Historic Archæology in India," by Lt.-Col. D. H. Gordon is a harsh but not unconsidered evaluation of archæological studies in general. According to Col. Gordon, it is futile to expect Europeans and expeditions financed by them to take any sustained interest in Indian archæology for the simple reason that this country is not the land of the Bible. Though this writer's criticism of the work of scholars like Marshall, Mackay, Kramrisch, Stern and others, may sound Cassandra-like, it is an earnest and frank attempt of a good field-worker to diagnose some common scholastic diseases.

In the next article Mr. J. P. Mills describes the beliefs about *apotia* or accidental death among the *Lhota Nagas*. Other articles in the volume before us are "Anthropology in India and Ethnical Position of Indians" by Col. Germano da Silva Correia, "Indian Oil-Presses and Oil Extraction" by Prof. K. P. Chattopadhyay, "A Proposed Correlation of the Nasal Elevation Index" by Mr. S. S. Sarakar, and "Fishhooks in North America and their Distribution" by Dr. B. Bonnerjea.

A. A.

Tuberculosis in India

THE *Indian Medical Gazette* has for the third year in succession published a special tuberculosis number. The editor, Dr. L. E. Napier, sums up the reasons for this departure from the usual practice of the *Gazette*, which is a journal for the general practitioner in India and in no sense a specialist journal. He points out that a special effort is being made by the whole nation to tackle the tuberculosis problem and he feels that everyone should join in and support Lady Linlithgow's movement. The second reason is to show the practitioner in India what is being done, both in this country and abroad, for the tuberculous patient, to impress upon him that a very great deal can be done and that practically no case is hopeless, so that he in turn will pass on the information and will counteract a spirit of hopelessness which would be fatal to the movement.

He writes, "A perhaps not unnatural reaction to the enthusiasm of the early days of the launching of the appeal is now appearing and the people who helped to raise the fund are asking how the problem is going to be tackled, some in an interested and helpful spirit, others querulously and with a suggestion of hopelessness. 'What is the good', the latter say, 'of pointing to the successful campaigns in other countries, countries that are able and prepared to spend hundreds of pounds per tuberculosis death on sanatoria and tuberculosis hospitals, when we cannot afford as many pice for this special purpose?' But we shall not tackle the problem on the lines that they are doing it in Western countries and we should not do so even if we had the necessary resources; we shall devise means suited not only to our limited resources but to the special conditions of the country. Whilst the balance is certainly in favour of the richer Western countries, we have some factors that work in our favour, the sun, for example, and the relatively small proportion of our children that live under the conditions comparable to those of

the grinding poverty and squalor of the overcrowded, sunless slums of many large European cities."

He continues, "The control of the disease is so closely associated with the treatment of the existing cases that one cannot dissociate the two ideas. The anti-tuberculosis programme will of course include the building of sanatoria, up-to-date and well-equipped dispensaries, and after-care settlements, to act as models and to show what can be achieved under the most favourable conditions, but in such institutions, as with the funds available we could hope to found, scarcely one per cent. of our patients could be accommodated, and we shall certainly not be content to leave matters there: something must be done for the remaining 99 per cent., and tuberculosis dispensaries, conducted on more modest, but still we hope up-to-date lines, will have to be established, not only in every province and district but eventually in every *thana* or *taluk* in the country."

The third reason for the publication of these special numbers is that the services of a special Editorial Committee of the Tuberculosis Association of India were offered; this Committee collected a number of important papers from the leading tuberculosis workers in India, and the special Tuberculosis Number consists of a valuable collection of articles which form an important contribution to the science of phthisiology as applicable in Eastern and Tropical countries.

There is an important article by Professor Lyle Cummins, one of the leading authorities in Great Britain and one who has made a special study of tuberculosis under tropical conditions. He points out that, in many of the populations which are being attacked in India, tuberculosis is a comparatively new experience and therefore it takes on a particularly virulent form.

Dr. Frimodt Moller has written a very practical and important article on the designing of dispensaries and sanatoria; detailed plans are reproduced.

The extreme seriousness of the tuberculosis problem in India is brought out by a survey that has been carried out near Madras by Dr. Benjamin and his co-workers. He estimates that about one in every forty persons in this town is suffering from active tuberculosis and requires immediate treatment.

There are some very useful clinical articles by Dr. A. C. Ukil, K. N. De, and P. K. Sen.

There is an important contribution on the surgical treatment of tuberculosis by Dr. W. M. G. Jones, Superintendent of the Wanless Tuberculosis Sanatorium. This form of treatment has assumed considerable importance in Europe and America during the last few years and it constitutes the greatest advance in treatment, especially in the type of case that a few years ago was considered hopeless.

This Special Number will be very much appreciated by medical men in India and we believe that it will do much to stir up interest in this very important subject and to provide encouragement for the tuberculous and those who are attempting to help them.

Isotopes and Hyperfine Structure

(A Brief Review)

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THE existence of hyperfine structure in spectral lines was first discovered by Michelson[1] employing an indirect but ingenious method of visibility measurements on his interferometer. This method has since been superseded by more direct methods of analysis, which require such high resolving power instruments as Fabry-Perot etalons, Lummer-Gehrcke plates, echelon spectroscopes and concave gratings. Analysis of spectral lines led only to an accumulation of observational data and the origin of hyperfine structure remained obscure till 1924. It was in this year that Pauli[2] suggested that the structure is to be attributed to a small magnetic moment associated with the spinning nucleus. Measurements of the intensities of the components soon revealed that in addition to this effect the different isotopes of the element were in many cases responsible for additional complications in the hyperfine structure patterns. It has been since found that the isotope with the nuclear spin moment is invariably an odd isotope and depending on the magnitude of the magnetic moment a wide or narrow structure is displayed. All the components arising from even isotopes on the other hand are sometimes grouped together in one intense line or in some instances appear separately at approximately equal intervals. Spectral lines of both these types often occur in the spectrum of the same element. Thus the hyperfine structure of a spectral line is intimately connected with the isotopic constitution of the element; while the even isotopes contribute at best a single component for each isotope, the odd isotopes in virtue of their mechanical and magnetic moments give rise to a larger number of components. An additional fact of importance is that the total intensity of the components arising from any given isotope is strictly proportional to its abundance. The centre of gravity of the components due to an odd isotope either falls in between the nearest even isotopes or coincides with the main line when there is no even isotope separation. Thus the elements in the Periodic Table can be classified into groups which contain only odd isotopes and display spin structure or those which consist of both odd and even isotopes and yield a structure with or without even isotope displacement. A brief review of the available results obtained from a study of the hyperfine structure of spectral lines in relation to the isotopic constitution of the elements is given below.

Elements with only ODD isotopes.—Elements with odd atomic number generally have either one or two odd isotopes. In the case of those elements which have only one odd isotope the hyperfine structure, if any, arises from a nuclear spin; there can obviously be no isotope structure. When the element contains two odd isotopes, they can have the same or different mechanical or magnetic moments and may display an isotope shift in some levels. Table I gives the known values of mechanical and magnetic moments of the odd isotopes of the odd atomic number elements and wherever two values are given they refer respectively to the two isotopes of the element.

TABLE I

Atomic number	Element	Isotopes	Nuclear spin moment	Magnetic moment in proton magnetons
(1	H	1, 2	1/2, 1 Band spectrum	2·5, 0·85
3	Li	6, 7	1, 3/2	0·85, 3·3
5	B	10, 11	.., 3/2	0·597, 2·682
7	N	14	1	0·402)
9	F	19	1/2	2·64
11	Na	23	3/2	2·0
13	Al	27	5/2	~3·7
15	P	31	1/2 (B.S.)	..
17	Cl	35, 37	5/2?, ?	<0·3

[1] *Phil. Mag.*, 1891, **31**, 338.
[2] *Naturwiss.*, 1924, **12**, 741.

TABLE I—*(Contd.)*

Atomic number	Element	Isotopes	Nuclear spin moment	Magnetic moment in proton magnetons
19	K	39, 41	3/2	0·36, 0·20
21	Sc	45	7/2	4·6
23	V	51	7/2	..
25	Mn	55	5/2	..
27	Co	59	7/2	~2·5
29	Cu	63, 65	3/2	2·5, 2·6
31	Ga	69, 71	3/2	2·0, 2·5
33	As	75	3/2	1·5
35	Br	79, 81	3/2	2·6
37	Rb	85, 87	5/2, 3/2	1·3, 2·6
39	Y	89	1/2?	..
41	Nb	93	9/2	3·7
45	Rh	103	1/2 ?	..
47	Ag	107, 109	1/2	−0·1, −0·2
49	In	115	9/2	5·3
51	Sb	121, 123	5/2, 7/2	3·7, 2·8
53	I	127	5/2	~3
55	Cs	133	7/2	2·5
57	La	139	7/2	2·8
59	Pr	141	5/2	..
63	Eu	151, 153	5/2	3·4, 1·5
65	Tb	159	3/2	..
67	Ho	165	7/2	..
69	Tu	169	1/2	..
71	Cp	175	7/2	2·6
73	Ta	181	7/2	..
75	Re	185, 187	5/2	3·3
77	Ir	191, 193	1/2, 3/2	..
79	Au	197	3/2	0·2
81	Tl	203, 205	1/2	1·45
83	Bi	209	9/2	3·6

The above table shows that the hyperfine structure study of the spectral lines from elements of odd atomic number is fairly complete.

Elements of even atomic number.—A number of odd and even isotopes are usually grouped together in each element of even atomic number. Of these isotopes those with even mass number have not given any evidence of spin structure, which only means that their nuclear magnetic moments are invariably zero or negligibly small. The hyperfine structure methods are inherently unable to distinguish between zero spin and zero magnetic moment; hence the even isotopes are generally assumed to possess no nuclear spin moment. Despite the fact that no spin structure is in evidence due to the even isotopes, they often give rise to separate components so that each even isotope is individually represented in the hyperfine structure pattern. In such cases the agreement in the relative intensities of the components with the known even isotopic constitution of the element is the criterion for assuming the existence of the isotope shift. The spacing of the components will generally be fairly equal for equal difference in mass numbers. The only known exception of this empirical rule is found in samarium where the separation of the isotopes Sm^{150} and Sm^{152} is twice as large as that of the isotopes Sm^{152} and Sm^{154}; this difference has been traced to an entirely alien factor connected with the α-activity of samarium. With regard to the odd isotopes of these even atomic number elements they display a spin structure whose centre of gravity lies between the two consecutive even isotopes on either side; again it is a matter of observation that the centre of gravity of the odd isotope lies nearer to the lighter even isotope. When there is no even isotope separation, the most intense component usually represents the superposition of all the components arising from the various even isotopes and the centre of gravity of the odd isotope patterns coincides with the main line. Table II gives the mechanical and magnetic moments of the odd isotopes of elements with even atomic number and indicates that the study of such elements is far from complete.

Spin structure.—With the introduction of a nuclear spin quantum number I a given gross multiplet level of an atom with its inner quantum number J splits into a tiny hyperfine multiplet whose component levels are characterised by the fine quantum numbers F, which can take all values from I + J to I ~ J. The resulting number of hyperfine

TABLE II

Atomic number	Element	Odd isotopes	Nuclear spin moment	Magnetic moment
30	Zn	67	5/2	0·9
32	Ge	73	..	~0
34	Se	77	1/2 ?	~0
36	Kr	83	9/2 ?	−1·0
38	Sr	87	9/2	−1·1
42	Mo	93, 95	1/2	..
46	Pd	105	1/2 ?	~0
48	Cd	111, 113	1/2	−0·65
50	Sn	115, 117 119, 121	1/2	−0·9
54	Xe	129, 131	1/2, 3/2	−0·8, 0·7
56	Ba	135, 137	3/2	0·9
62	Sm	147, 149	..	..
70	Yb	171, 173	1/2, 5/2	..
78	Pt	195	1/2	0·6
80	Hg	199, 201	1/2, 3/2	0·5, −0·6
82	Pb	207	1/2	0·6

levels becomes $2I+1$ or $2J+1$ according as $I \leqslant J$ or $J \leqslant I$. On the vector model of the atom the interaction energy of the nuclear magnet in the magnetic field due to the extranuclear electrons is given by

$$E = a\ IJ\cos(IJ)$$
$$= \tfrac{1}{2}a\,[F(F+1) - I(I+1) - J(J+1)]$$
$$= \tfrac{1}{2}aC$$

after embodying the quantum mechanical corrections. The energy difference between two consecutive hyperfine structure levels with fine quantum numbers F and $F+1$ is

$$\Delta E = a(F+1),$$

which shows that the Lande interval rule should be applicable quite rigidly in the case of hyperfine levels. Careful measurements have recently revealed in some elements minute departures from the Lande interval rule indicating thereby a want of spherical symmetry in the nuclear charge distribution. The deviations therefore have been traced by Casimir[3] to an electric quadrupole moment for the nucleus. The interaction energy levels are then given by

$$E = \tfrac{1}{2}aC + bC(C+1),$$

where a and b are the interval rule and quadrupole interaction constants respectively. Computations based on Casimir's formulæ give for the nuclei the quadrupole moments as mentioned in Table III, where the positive sign indicates that the charge distribution in the nucleus is elongated along the spin axis and the negative sign means an oblate spheroidal distribution of charge.

TABLE III

Atomic number	Element	Isotope	Quadrupole moment $q \times 10^{24}$ cm.^{2}
29	Cu	63, 65	−0·1
31	Ga	69, 71	+1·0, 0 ± 0·5
33	As	75	+0·3
36	Kr	83	+0·04
49	In	115	+0·84
54	Xe	131	$\leqslant$ 0·03
63	Eu	151, 153	+1·2, +2·5
71	Cp	175	+5·9
75	Re	185, 187	+2·6
80	Hg	201	+0.5
83	Bi	209	−0·4

Transition between two sets of hyperfine levels occurs such that $\Delta F = 0$ or ± 1 without exception and the relative intensities of the hyperfine components can be computed from the intensity rules rederived on the quantum mechanics by Dirac[4] with suitable modifications for the case of hyperfine structure. Forbidden transitions in hyperfine structure have not so far been observed.

Isotope structure.—The isotope displacement to be expected on the basis of a variation in the Rydberg constant from isotope to isotope on the basis of the Bohr theory is obtained in the case of hydrogen isotopes H^1 and H^2. If the isotope shift in such cases arises solely from a change in the nuclear mass, the wave-number shift can be computed from $\Delta\nu = \nu\,\Delta M/1838M^2$, where M is the mean value of the mass numbers of the two isotopes and ΔM their difference. Even the isotope separation in argon lines indicates that with the exception of $1s_2$ term the displacements of the other terms can be

[3] *Physica*, 1935, **2**, 719.

[4] *Proc. Roy. Soc.* (A), 1926, **111**, 281.

explained on the previous considerations.[5] But in the case of heavy elements like Pt, Hg, Tl, etc., the observed isotope displacements are too large and several attempts have been made to account for it. Postulates such as the deviation of the nuclear electric field from being Coulombian or the variation in the inherent structure of the nuclei with the consequent changes of size and shape from isotope to isotope have been tried. With Goudsmit's extension of Lande's formula for $(\overline{1/r^3})$ where r is the nuclear radius, Breit has found it possible to explain the order of magnitude of the isotope displacements in Hg, Tl and Pb lines on the hypothesis of small changes in nuclear radii. Breit's theory[6] of isotope shift indicates in general that the greatest isotope displacements are to be expected in levels involving two tightly bound s-electrons like $5d^4\ 6s^2$. Experimental data for the isotope shifts in the spectroscopic levels of many elements are now available and await a more complete theoretical interpretation. Table IV gives the electron configurations for which the isotope shifts have been observed as well as the mean magnitude of this shift for a change of two units in the isotope mass; the positive sign denotes that the heavier of the two isotopes lies deeper.

TABLE IV

Atomic number	Element	Electron configurations and terms for which isotope displacements are observed	Mean value of isotope shift for $\Delta M = 2$, in cm.$^{-1}$
1	Ne	Terms : 1s	+0·107
		2p	+0·048
		2s	+0·040
		3d	+0·032
12	Mg	3^1P	+0·056
		n^1D	$-0·240/n^2$?
17	Cl	Cl II $4s\ ^5S_2$	−0·035
18	A	1s	−0·025
		2p	−0·015
		3p	−0·008
29	Cu	$3d^9\ 4s^2\ ^2D_{3/2}$	+0·073
		$3d^9\ 4s^2\ ^2D_{4/2}$	+0·085
30	Zn	Zn II $3d^9\ 4s^2\ ^2D_{3/2, 4/2}$	+0·094
35	Br	$5p\ ^4D_{7/2}$	+0·007 ?
42	Mo	$4d^4\ 5s^2\ D_{01234}$	−0·015 ?
48	Cd	Cd II $4d^9\ 5s^2\ ^2D_{3/2, 5/2}$	−0·051
50	Sn	$5d\ ^2D_{3/2}$	0·020 ?
62	Sm	..	0·060
74	W	$5d^4\ 6s^2\ ^5D$	−·052
75	Re	$5d^5\ 6s^2\ ^6S_{5/2}$	−0·064 ?
76	Os	$5d^6\ 6s^2\ ^5D_4$	−0·065
77	Ir	$5d^8\ 6s\ ^4F_{9/2}$?	+0·057
78	Pt	$5d^9\ 6s\ ^3D_3$	−0·082
		$^3D_2$	−0·117
		$^3D_1$	−0·090
		$^1D_2$	−0·123
		$5d^8\ 6s^2\ ^3F$	−0·203
		$5d^8\ 6s\ 6p\ ^5D_4, ^5G, ^5F_5$	−0·110
80	Hg	Hg I $5d^9\ 6s^2\ 6p^1\ p_1$	−0·150
		$5j^{10}\ 6s^2\ ^1S_0$	−0·165
		$5d^{10}\ 6s\ 7s\ ^1S_0$	−0·030
		$5d^{10}\ 7s\ ^3S_1$	−0·030
		$5d^{10}\ 6s\ 8s\ ^3S_1$	−0·020
		Hg II $5j^9\ 6s^2\ ^2D_{5/2}$	−0·500
		$5d^9\ 6s\ 6p\ ^2D_{5/2}$	−0·080
81	Tl	Tl I $5j^{10}\ 6s^2 6p\ ^2P_{3/2}$	+0·055
		$5d^{10}\ 6s^2 6p\ 2P_{1/2}$	+0·060
		Tl II $5d^9\ 6s^2\ ^1P_1$	−0·290
82	Pb	Pb I $6s^2\ 6p^2\ ^1S_0$	+0·068
		$6s^2\ 6p^2\ ^1D_2$	+0·086
		$6s^2\ 6p^2\ ^3P_2$	+0·090
		$6s^2\ 6p^2\ ^3P_1$	+0·085
		$6s^2\ 6p^2\ ^3P_0$	+0·083
		$6s^2\ 6p\ 6d\ ^3D, ^3F$	+0·030
		Pb II $6s\ 6p^2\ ^2D_{5/2}$	+0·288
		$6s\ 6p^2\ ^2D_{3/2}$	+0·434
		$6s^2\ 6d\ ^2D_{5/2}$	+0·205
		$6s^2\ 6d\ ^2D_{3/2}$	+0·089
		Pb III $6s^2$?	+0·500

The alteration in the sign of the isotope displacements from the arc to the spark spectrum as in thallium along with the random variation of the shift and its sign even in the same electronic configuration like $d^9\ s^2$ of elements such as copper, zinc, cadmium and mercury invalidates the general applicability of Breit's theoretical considerations. The solution of the problem of isotope displacement is therefore considered to be in an unsatisfactory stage and it is hoped that it will soon receive the attention it deserves at the hands of the theoretical physicist.

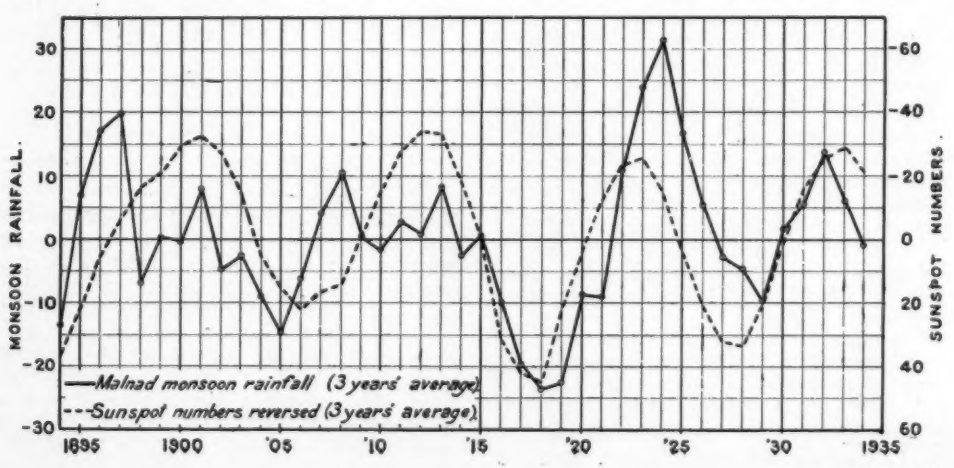
[5] Kopfermann and Kruger, *Zeits. f. Physik*, 1937, **105**, 389.

[6] *Phys. Rev.*, 1932, **42**, 348.

LETTERS TO THE EDITOR

Sunspots and Mysore Rainfall

In trying to improve the regression formula for Mysore rainfall given in *Current Science*, April 1938, it was found that sunspot numbers would serve as a useful factor for foreshadowing the Malnad rain. The average rainfall for the Malnad area during the monsoon season, June to September, is 85″ based on the average of the nine Taluk stations, Sagar, Hosanagar, Thirthahalli, Sorab, Sringeri, Koppa, Mudigere, Narasimharajapura and Saklespur, for the years 1893 to 1935. The coefficient of correlation between the annual sunspot number and the monsoon rainfall of the Malnad in the same year is $-\cdot38 \pm \cdot09$; the coefficient with the monsoon rainfall of the preceding year is $-\cdot26 \pm \cdot10$, and that with the monsoon rainfall of the following year is $-\cdot35 \pm \cdot09$. If we use three-year averages instead of individual year's data the contemporary coefficient between sunspot number and Malnad rain increases to $-\cdot50 \pm \cdot08$. Curves showing the three-year averages of Malnad rain and sunspot number reversed are shown in the figure below.



The opposition between Malnad rain and sunspot number is more clearly shown if we consider the years of sunspot maxima and minima. The best method of bringing out the relation seems to be to consider the average figures for three years at sunspot maximum and at sunspot minimum. Since 1893 there have been five sunspot maxima and four sunspot minima. For the epochs of sunspot maxima and minima, the sunspot numbers and the departures from normal of monsoon rainfall in the Malnad for the years preceding, contemporary with and succeeding the year of sunspot maxima or minima are given in Table I; the mean of the departures for the three years is also given in the last column. This table shows that on the average of the three years sunspot maxima were associated with deficient rains and sunspot minima with excess rain. The year 1923, one of the years of sunspot minimum was the wettest year on record for the Malnad.

TABLE I

Sunspots and Malnad Monsoon Rain

Year	Sunspot numbers	Rainfall Departures			
		Preceding year −1	Same year 0	Following year +1	Average of 3 years
		"	"	"	"
		Sunspot Maxima			
1893	85	1·2	−16·2	−13·9	−6·9
1905	63	0·3	−27·6	−16·4	−14·6
1917	104	−1·5	−11·9	−45·5	−19·6
1928	78	0·9	−15·1	0·9	−4·4
1937	115	−8·7	−10·3	−11·9	−10·3
		Sunspot Minima			
1901	2·7	37·8	−5·1	−8·1	8·2
1913	1·4	16·1	−10·3	18·8	8·2
1923	5·8	−14·2	50·3	35·2	23·8
1933	5·6	12·8	9·9	−4·2	6·2

Similar data for the monsoon rainfall in the Maidan region of Mysore are given in Table II. They do not indicate any relation between sunspot number and Maidan rainfall, a fact confirmed by the insignificant correlation coefficient between the two.

TABLE II

Sunspots and Maidan Monsoon Rain

Year	Sunspot numbers	Rainfall Departures			
		Preceding year −1	Same year 0	Following year +1	Average of 3 years
		"	"	"	"
		Sunspot Maxima			
1893	85	2·5	−1·0	−4·0	−0·8
1905	63	−3·8	−4·3	4·9	−1·1
1917	104	3·8	5·0	−5·8	1·0
1928	78	0·8	−2·9	−1·3	−1·1
1937	115	2·7	−1·4	6·2	2·5
		Sunspot Minima			
1901	2·7	0·4	−1·9	−2·6	−1·4
1913	1·4	4·4	0·6	−2·9	0·7
1923	5·8	−5·2	−0·5	3·1	−0·9
1933	5·6	1·4	3·5	−6·0	−0·4

Table III gives similar data of rainfall departures for the whole of the Mysore State for the whole year. Taking the average of the three years the departures are positive in all the four occasions of sunspot minima, and negative in four out of five occasions of sunspot maxima; but the departures are not high.

TABLE III

Sunspots and Mysore Annual Rainfall

Year	Sunspot numbers	Rainfall Departures			
		Preceding year −1	Same Year 0	Following year +1	Average of 3 years
		"	"	"	"
		Sunspot Maxima			
1893	85	−2·3	4·9	−2·9	−0·1
1905	63	−2·8	−6·8	3·8	−1·9
1917	104	11·7	5·3	−8·2	2·9
1928	78	−4·5	−0·3	3·2	−0·5
1937	115	−0·9	−2·2	−5·0	−2·7
		Sunspot Minima			
1901	2·7	3·3	3·3	2·4	3·0
1913	1·4	9·6	−2·6	0·2	2·4
1923	5·8	−1·9	−0·3	4·4	0·7
1933	5·6	12·3	12·5	−6·9	6·0

The foregoing analysis indicates that it is only in the Malnad region that there is a fairly marked association between sunspots and rainfall. It may be stated in a general way for this region that in years of maximum sunspots there is likely to be deficient monsoon rain and in years of minimum sunspots an excess of monsoon rainfall.

If there was a strict regularity about the sunspot cycle, and the maxima recurred at regular intervals of 11 years, we would have an extremely valuable indication, well in advance, of years of deficient monsoon rainfall in the Malnad. But as H. T. Stetson has pointed out in his book, *Sunspots and Their Effects*, although the average interval from one sunspot maximum to the next is 11·13 years, the interval has sometimes been as long as 16 years, and sometimes as short as 8 years.

If we include the correlation coefficient of − ·35 between the sunspot number and the Malnad monsoon rainfall of the following year, in the regression formula for Malnad rain given in *Current Science*, April 1938, the multiple correlation coefficient increases from ·52 to ·60, the increase being significant.

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Scanning of the Hysteresis Loop in Sorption

By the extensive work of Allmand and collaborators,[1] Lambert[3] and Foster,[2] the phenomenon of "Hysteresis in Sorption" was established as real. The exact cause of the phenomenon has yet been a matter of controversy and it has been explained by investigators from various points of view. During recent times, the explanation based on the concept of cavities having narrow necks,[4] seems to be gaining support. With a view to elucidate the exact cause of this phenomenon, the hysteresis loop obtained in the sorption of water on titania gel has been scanned, by traversing the loop from various intermediate points on the sorption and desorption curves. The scanning of hysteresis loop has revealed certain characteristics which form a convincing proof of the cavity concept, as a general cause of hysteresis.

Sorption and desorption of water vapour at 30° C. were conducted on titania gel activated at 300° C. and degassed in vacuum for five hours. The quartz fibre spring technique was employed in the work. The system exhibits hysteresis, the reproducibility of which is remarkable unlike rice-water system.[5] The hysteresis loop has been traced after thirty sorptions and desorptions. The loop has been scanned by trying sorption and desorption at various points on the desorption and sorption curves respectively, forming the hysteresis loop (Fig. 1). If desorption is effected at any intermediate point on the sorption curve, the loop is crossed and the desorption curve is reached. The course followed on effecting sorption, starting from any intermediate point on the desorption curve is, however, different. Instead of the sorption curve being reached, the

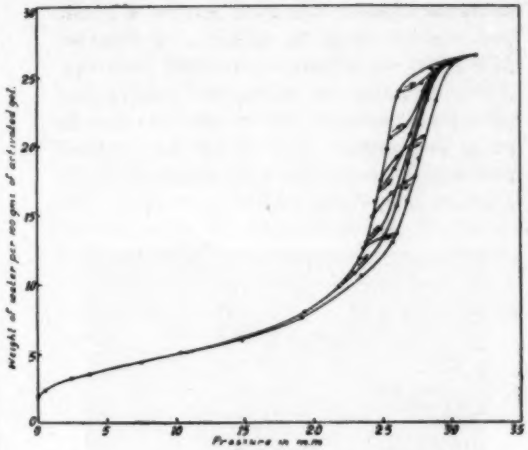

FIG. 1

path traces an independent curve till it reaches the peak of the hysteresis loop. In these experiments, the starting points on the sorption and desorption curves were reached from the zero and the saturation pressures respectively.

These significant observations are satisfactorily explainable only on the basis of the cavity concept. In the porous titania gel, there are capillaries of varying shapes and dimensions. Some of them are V-shaped pores and some are cavities having narrow necks, the latter alone being responsible for the hysteresis effect. During sorption these cavities are filled up in the same way as the V-shaped pores. During desorption, however, they get emptied only when they are exposed to pressures below the minimum at which water condensed in the necks of the cavities will just be in equilibrium with the vapour. At any point along the sorption curve forming the hysteresis loop there are always some cavities filled with water. When desorption is effected some of the water is entrapped and consequently the hysteresis loop is crossed till the main desorption curve is reached. At points along the desorption curve, there are some of the bigger cavities yet unemptied. When sorption is tried at these points separate curves are traced in juxtaposition to the main sorption curve and all these curves reach the peak of the hysteresis loop.

In another investigation on the scanning of the hysteresis loop obtained in the sorption of water on silica gel, exactly similar results have been obtained. The results on the scanning of the hysteresis loop definitely prove that a cavity completely filled with the liquid is emptied only when it is exposed to a pressure less than what is just sufficient for water in the neck of the cavity to be in equilibrium with the vapour, whereas the hysteresis loop itself can be caused even by a slight lowering from the minimum pressure which is enough to completely fill the cavity with the liquid. If a cavity has two or more necks of different dimensions, it is the largest neck that determines the pressure at which the emptying of the cavity takes place. It follows from the cavity concept that the true equilibrium curve is the sorption curve because along the desorption curve, the cavities retain the liquid in a metastable equilibrium and that the hysteresis effect in all porous adsorbents must be a rule rather than an exception. One of the causes, however, for the nonexistence or the disappearance of the hysteresis effect has been shown to be the elasticity of the cavity wall.[5]

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Department of Chemistry,
Central College,
Bangalore,
September 29, 1939.

[1] Allmand, Hand and Maning, *J. Phys. Chem.*, 1929, **33**, 1694.
[2] Foster, *Proc. Roy. Soc.* (Lond.), 1934, **146A**, 129.
[3] Lambert and Foster, *Ibid.*, 1932, **136A**, 363.
[4] McBain, *J. Amer. Chem. Soc.*, 1935, **57**, 699.
[5] Rao, *Curr. Sci.*, 1939, **8**, 256.

Alleged Optical Isomerism of 6-Co-ordinated Cupric Salts

IN general, cupric ion does not form 6-co-ordinated compounds and readily stops at four. In 1927 Wahl[1] claimed to have prepared a lævorotatory diaquo bis ethylene diamino cupric iodide $[Cu\ en_2\ (H_2O)_2]I_2$. It is obvious that a cation $Cu(en)_2$ would be inactive and it is

only the formation of a 6-co-ordinated complex by means of two water molecules that could make the activity possible. Further, the complex must have to be remarkably stable: if the latter were even partially dissociated off in solution, the compound would racemise. Johnson and Bryant[2] on reinvestigation found that Wahl's iodide dihydrate effloresces in air and the constitution of the complex ion in the crystal is $[Cu(en)_2]^{++}$, the co-ordination valency being four, not six. Optical isomerism is therefore excluded. The authors state that the ion $[Cu\ en_2(H_2O)]^{++}$ even if formed in aqueous solution, is too unstable to permit of resolution. The present observation is in agreement with this remark in so far as the analogy between the structures $[Cu\ en_2-(H_2O)_2]I_2$ and $[Cu\ pn_2\ (H_2O)_2]I_2$ may be regarded as relevant. It has been found that in diaquo bis propylene diamino cupric iodide, one molecule of water is very loosely held and the crystals of the diaquo compound rapidly lose their lustre and form the monohydrate. A 6-co-ordinated cupric ion, therefore, does not exist in the solid state and the presence of octahedral configuration cannot be said to have been established in the case of copper by optical resolution.

KAMAI LAL MANDAL.

Department of Chemistry,
Presidency College,
Calcutta,
October 6, 1939.

[1] *Soc. Sci. Fenn. Phy. Math.*, 1927, **4**, 14.
[2] *J. C. S.*, 1934, 1783.

Twig Blight and Fruit Rot of Mango

IN Bombay mango trees become affected in the monsoon by a disease producing on the twigs water-soaked areas, which rapidly enlarge in extent. Invariably there is a rapid upward extension of the invaded region, and the lateral spread is quite limited in extent and never girdles the twig. The affected bark ultimately turns dark brown, and the shoot dries up (Fig. 1). Numerous dark brown pycnidia are formed at the margin of the invaded region of the bark, but in the affected area their number is small. They measure from 88 to 248 μ in diameter (56·8 to 145·5 μ in culture) and have an ostiole, which perforates the epidermis. The hyaline pycnospores measure 16·5 to 26·1 by 4·8 to 6·9 μ. The disease also affects the ripening fruit during storage and produces a black rot especially at the stalk-end of the fruit.

FIG. 1

Showing the drying up of twigs of mango trees due to infection with *Phoma* sp.

A species of *Phoma*, which is probably new to science, was readily isolated from the diseased bark and was also obtained from naturally infected mango fruits. Inoculation experiments on wounded stems with 3 to 4-week-old cultures of the fungus grown in potato-dextrose agar gave positive results. In inoculation experiments a vertical slit was made in the bark with a sharp knife, and bits of mycelium were applied to the cut surface and covered with paraffin or wrapped over with wet cotton wool. In about 72 hours water-soaked areas appeared round the slits, and infection spread more rapidly towards the apex of the twig than at the sides, ultimately killing the twig. Green twigs of *Pairi* and *Alphonso* varieties of mango between the ages of one and two years are highly susceptible to infection, whilst younger shoots and those with mature bark fail to take

infection. Twigs of country varieties are highly resistant.

Similar inoculation experiments were made with mango fruits which were slightly wounded near the stalk-end. Young inoculum was applied to these wounds, which were subsequently covered with paraffin or wet cotton wool. The inoculated fruits were incubated at 27° C. Typical black rot developed in the inoculated fruits within 72 hours. Inoculation experiments on wounded fruits further showed that infection develops more rapidly in *Pairi* than in *Alphonso* or other varieties of mango.

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B. N. UPPAL.

College of Agriculture,
Poona,
October 3, 1939.

On the Occurrence of *Apus* in Gujarat, Western India

Apus is an ancient genus of fresh-water Phyllopoda which occurs practically all over the world. It has been reported from some parts of India also[1]; but our knowledge of its distribution in this country is far from being complete. This is largely due to the fact that *Apus* with its archaic form is ill suited for migration from isolated muddy ponds in which it occurs during the monsoons. No sooner it appears than it disappears; it seldom lives for more than three weeks. Its distribution is, therefore, often erratic.

In the last August, while looking for plants of *Marsilea minuta* in some small sheets of water collected during rains in the vicinity of the Gujarat College, Ahmedabad, and some other places, I was able to collect a large number of fresh-water Crustacea which contained, *inter alia*, many specimens of *Apus*—presumably *cancriformis*—similar to those from Kashmir.[2] This was rather surprising as the only form of *Apus* known so far from peninsular India was *Apus asiaticus* reported by Gurney[3] from the famous Panchgani locality in the Bombay Presidency. The occurrence of another form of *Apus* in this Presidency, therefore, is a matter of considerable interest. Possibly, this is another piece of evidence in support of the belief in the African element in the fresh-water fauna of Western India. The reasons for such a view are obvious: *Apus cancriformis*, not distantly related to *Apus asiaticus*, occurs in Morocco, Cyrenaica, North Africa, Eritrea, Asia Minor, Kashmir, United Provinces[4] and some other places. It is unlikely, therefore, that it occurs in Gujarat (Western India) by mere chance.

A detailed statement in elucidation of this view based on a comparative study of *Apus asiaticus* and *Apus cancriformis* will be published elsewhere.

T. S. MAHABALÉ.

Department of Biology,
Gujarat College, Ahmedabad,
September 28, 1939.

[1] Kemp, *Rec. Ind. Mus.*, 1911, **6**, 353; Gurney, *Ibid.*, 1925, **27**, 439.

[2] Gurney, *loc. cit.*, p. 439.

[3] ———, *Ann. Mag. Nat. Hist.*, 1924, **14**, (9), 566 see also *loc. cit.*, p. 440.

[4] Walton, *Rec. Ind. Mus.*, 1911, **6**, 351.

A Note on the Development of the Female Gametophyte in Some Indian Compositæ

LITERATURE on the gametogenesis of the members of Compositæ is very extensive. Very little work in this direction has, however, been done in India. The investigations of Bhargava[1] on *Eclipta erecta* and Banerji[2] on *Carthamus tinctorius* could be mentioned only in this connection.

A comparative study of the development of the flower, pollen grains and embryology in *Mikania cordifolia*, *Launea asplenifolia* and *Blumea laciniata* is in progress since 1938. This note gives a general account of the development of the female gametophyte in the abovementioned plants. A full account of the investigation will be published shortly elsewhere.

The archesporial cell is hypodermal in origin in all the three plants. It functions directly as the megaspore-mother cell. After the completion of the reduction division a linear tetrad

of megaspores is noted in every case. In no case was a "T-shaped" tetrad observed. The megaspores become deep-seated on account of the division of the 'cover' cells. The upper three megaspores degenerate and the chalazal one becomes functional. By three successive divisions it produces an eight-nucleate embryo-sac. The mature gametophyte is of the normal angiospermous type. The synergids have pointed ends and the polar fusion nucleus lies close to the egg. In *Mikania cordifolia* and *Blumea laciniata* the antipodal cells are each binucleate, whereas in *Launea asplenifolia* the antipodal cells are uni-nucleate.

The author expresses his thanks to Mr. I. Banerji under whose guidance the work is being carried out.

SUNIL DATTA.

Department of Botany,
Calcutta University,
October 5, 1939.

[1] Bhargava, *Proc. Ind. Acad. Sci.*, 1935, **1**, No. 7.

[2] Banerji, Paper read at the 25th session, *Ind. Sci. Cong.*, (in the press).

Teratological Notes

ABNORMALITIES have been recorded in the following plants:—

(1) *Melia azedarach* Linn.

(2) *Elettaria cardamomum* Maton.

(3) *Musa sapientum* Linn.

(1) In normal flowers of *Melia azedarach* Linn., the staminal tube is dark purple, a little shorter than the petals, cylindrical, slightly dilated and laciniate at the mouth; anthers 10, within the tube at the apex. But the specimen investigated shows that the staminal tube has gone a step further in dilatation and a major part of it has actually expanded and assumed the shape and colour of a petal, but much longer than it (Figs. 1 and 2). It is interesting because it serves as a good example of petalody.

(2) Normal flowers of *Elettaria cardamomum* Maton contain only one perfect stamen, that is, the dorsal stamen of the inner whorl is perfect, the other two combine in a petaliferous lip usually embracing the fertile stamen. The outer whorl is represented by two teeth-like staminodes. But the specimen under report, which is collected from the Botanic Garden, Osmania University, contains two perfect stamens instead of one which is characteristic of the Zingiberaceæ (Fig. 3). In this specimen the dorsal perfect stamen has bifurcated during

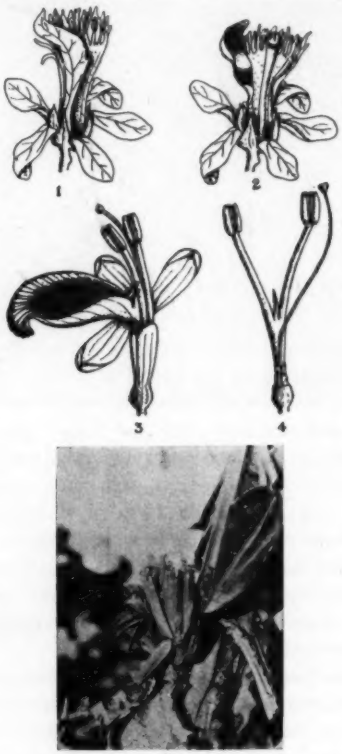

FIG. 1.—Flower of *Melia azedarach* Linn., showing the petaliferous staminal tube—dorsal view.

FIG. 2.—The same in ventral view.

FIG. 3.—Flower of *Elettaria cardamomum* Maton, with two stamens.

FIG. 4.—Bifurcated stamen with two arms bearing perfect anthers.

FIG. 5.—Photograph of *Musa sapientum* Linn., showing the abnormal inflorescence with female flowers only.

development, and the two arms of the filament bear two perfect anthers (Fig. 4).

(3) An interesting inflorescence of *Musa sapientum* Linn. has been observed in a plant growing in the house of one of us (Fig. 5). It is quite different from the abnormal inflorescences of this plant described by several workers like Dr. K. Biswas, Messrs. K. G. Banergee and G. P. Mozumdar. The specimen under discussion is interesting because the spike could not come out of the sheathing leaf-bases and the scape could not elongate. The inflorescence is a condensed spike, bursting out from the base of the crown of leaves as reported by Mr. S. C. Banergee. The flowers are all female, and due to their close aggregation the fruits could not attain their normal size.

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September 20, 1939.

Occurrence of *Cestum amphitrites* (Mertens) on the Madras Coast

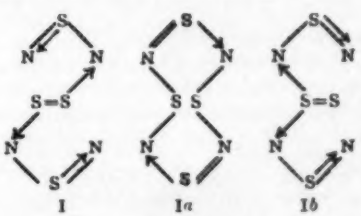
A beautiful specimen of this Cestoid Ctenophore was taken at 9 a.m. on the 15th August swimming gracefully at the surface of the sea, a couple of miles off the Senate House, Madras. At the time of capture a strong coastal current was flowing southwards. The specimen was in good condition when brought to the laboratory and moved with a slow serpentine movement and lived for more than three hours giving enough time for comparison with the description of the species given by Bigelow[1] from the Maldive Islands (1904, 1912). The ctenophore is nearly 25 mm. broad and about 210 mm. long. The body is flattened and tapers gradually towards the extremities. In a cross-section the body would appear rectangular since the oral side is as broad as the aboral side. Along the aboral side the ciliary bands extend from near the apical sense organ to the extremity of the band-like body on either side. No such ciliary bands are present along the oral edge of the animal. Instead this side is marked by a narrow groove flanked on either side by a low narrow ridge running from the centre towards the extremities. The stomach was perfectly transparent and no food could be detected in it. The vibratile combs are not prominent and some had ceased to act. The rather stout cilia of the two long aboral ciliary bands work actively. Along this aboral edge particularly, the animal is characterised by a peculiar iridescence. But the most important feature is the presence of two beautiful orange patches one at either end of the band-shaped body. I am not aware of any record of this beautiful form from the east coast of India. Preservation of the animal with Lo Bianco mixture of 10 parts of 10 per cent. cupric sulphate with one part of saturated sublimate unfortunately was not a success and the animal fell into fragments and is now preserved in this condition.

R. Gopala Aiyar.
University Zoology Research
Laboratory, Madras,
September 29, 1939.

[1] H. B. Bigelow, *Bull. Mus. Comp. Zoology*, 1904, **39**, No. 9.
———, *Bull. Mus. Comp. Zoology*, 1912, **54**, No. 12.

Constitution of Sulphur Nitride

Recently Arnold, Hugill and Hutson[1] have assigned structure (I) with the corresponding resonance structures (I *a*) and (I *b*) to sulphur nitride, S_4N_4. They have given many reactions in support of these structures.



We have now determined the dipole moments of sulphur nitride in benzene at 30° C. We

have found the total polarisation P_1^{∞}, 44·5 c.c., electronic polarisation P_E, 33·75 c.c., and the dipole moment μ, $0{\cdot}72 \times 10^{-18}$ e.s.u. The solutions in benzene were very dilute, the substance being difficultly soluble in benzene. The total polarisation has also been confirmed in carbon tetrachloride and has been found to be 44·13 c.c. The substance is practically insoluble in other non-polar solvents.

Structures (I) and (I *a*) should have practically no moment, while structure (I b) should have an appreciable moment due to the link $>S=S$. The observed moment being $0{\cdot}72 \times 10^{-18}$ e.s.u. and hence we assign the structure (I *b*) to sulphur nitride, S_4N_4.

The dipole moment of the link $>S=S$ being unknown, we are studying the dipole moments of other related compounds, with a view to arrive at a more definite conclusion.

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October 11, 1939.

[1] *J.C.S.*, 1936 1645.

On the Correlation between Life-Duration and Respiratory Phenomena

THE paper entitled "The correlation between life-duration and respiratory phenomena," published by Prof. B. N. Singh in the *Proceedings* of the *Indian Academy of Sciences* (1935, 2B, 387–402), contains several statements and conclusions which require elucidation and, therefore, the following few remarks are offered by way of a contribution towards the same.

On p. 388 (para 4) Prof. Singh states: "As growth in plants is generally localised in more or less definite regions known as meristems, the bulk of the plant body consists of what may be termed the "inert" or "non-living materials". If the words "inert" and "non-living" were omitted and the word "non-growing" substituted in the preceding sentence, the statement would be correct to an extent. This is, however, a minor point and we shall now examine the conclusions arrived at from the experimental data presented.

On p. 394 (para 3) the author concludes: "The experimental findings thus lead us to the conclusion that the relatively greater steepness of the curve of respiration is correlated with the brevity of the life-duration, while flatness in the same corresponds to increased life duration."

We have nothing to say against this conclusion, but in the Section B, after again summarising the experimental observations, the author states (p. 395): "Thus from the observations recorded, the conclusion is forced upon us that the steeper the fall in the respiratory index of the actively growing region of the meristem, the shorter the life-cycle." He then continues: "The shortening in the longevity of the plant, thus, it would seem, is a function of the rate of respiratory energy release." There is here a change of position. After concluding that these two processes are correlated the author immediately suggests that one is a function of the other, but this does not necessarily follow.

The author further cites some data on the initial rates of respiration and the average rates of respiration during the life-cycle, in support of his conclusion but they show nothing more than a correlation between these two rates.

In conclusion it may again be emphasised that we agree with Prof. Singh so far as the correlation between the two processes, *viz.*, life-duration and respiratory rate, but his thesis on "the role of respiration during the life-cycle of a single crop in determining the duration of life", remains only a speculation.

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Punjab Agricultural College,
Lyallpur,
February 8, 1939.

REVIEWS

Protective Coatings for Metals. By Burns, R. M., and Schuh, A. E. (Reinhold Publishing Corporation, New York; Chapman & Hall, Ltd., London), 1939. Pp. 407. Price $6·50.

The art of coating of metals with a view to affording protection against corrosion as well as for ornamental purposes has been practised since antiquity. It is only in recent years that the mechanism of protective action has begun to be understood, as a result of which the number of available types of coatings, both organic and inorganic, has rapidly multiplied. In this book an attempt has been made to cover the whole field of protective coatings that are employed in the various branches of present-day industry. The field is so wide that each chapter of the book could well be expanded into a full-sized volume. The authors have, however, succeeded in condensing the material in such a way as to present a well-balanced account of the various aspects of the subject-matter, without sacrificing the essential details.

The book opens with a lucid and masterly summary of the mechanism of corrosion of metals, which serves as a guide to the general understanding of the subject-matter of the rest of the book. Then follow eleven chapters dealing with inorganic metallic coatings of various types, such as zinc, cadmium, tin, nickel, chromium, copper, lead, aluminum, brass, cobalt, tungsten, tantalum, noble metals, etc. Each of the types of coatings is discussed from different points of view—historical, technique of production, properties, field of application, limitations and defects, safeguards to be adopted against defects, etc. One of these chapters is devoted exclusively to the surface preparation processes applied prior to coating and another to the methods of testing serviceability of coatings.

Organic coatings of the paint and varnish type have been disposed of in three chapters, which deal with the composition of paints, varnishes, lacquers, etc., mechanism of film formation, testing and evaluation of protective films, painting practices, etc. Although this section of the book is somewhat brief, from the point of view of the importance and extent of the subject-matter, yet it cannot be denied that the material dealt with has been presented in a lucid and useful manner.

The final chapter is devoted to a brief discussion of other miscellaneous types of protective coatings not covered by the earlier chapters; these include electrolytic oxide coatings on aluminum, slushing compounds, chemical dip coatings, vitreous enamels, etc.

Throughout the book, literally hundreds of references are cited to original literature, which immensely increases the value of the book for use of students, research workers, and technologists engaged in industry. Author and Subject Indexes are also included.

The book as a whole is well-planned, well-written and faultlessly produced with very few, if any, typographical errors. No technological or scientific library can afford to do without a copy of such an excellent book.

L. C. V.

Application de la Methode du Champ Self-Consistent aux Noyaux Atomiques. By M. Matricon. (*Actualités Scientifiques et Industrielles*, Hermann et Cie, Paris, No. 654), 1938. Pp. 1–83.

In the theory of the heavier nuclei which is not susceptible to rigorous treatment, the first approximation is the statistical method; but the results obtained by this method are more of a qualitative than of a quantitative significance. The next higher approximation is the Hartree method of the self-consistent field which is the topic systematically dealt with in this book.

After a short introduction to the principles of the method, the author establishes the general systems of equations for the determination of the individual wave functions, and the exact form of the energy expression. In addition to the self-consistent field arising on account of the Coulomb interactions, there is also a systematic consideration applied to an assembly formed by two sorts of distinct particles acted upon by exchange forces. The equations and the energy expression are obtained in a convenient form so as to bring out clearly the modifications they undergo when simplifying assumptions are made regarding the individual wave functions,

The second part, which is numerical, deals with the method of integration of the equations of the self-consistent field. A number of refinements are effected in the usual methods of numerical integration. A generalisation of Fock's method, and an application of the method of W. E. Milne (*Amer. Math. Monthly*, 1926, 33, 455) to determine the eigen-values and eigen-functions of Schrodinger's equations are two of the notable features of this chapter. The methods developed are applied to the treatment of the Helium nucleus and it is shown that the value of the energy thus obtained is nearer the experimental value than the value given by the usual Ritz method.

This book is bound to be of the greatest service to workers on nuclear physics. In the bibliography at the end of the book one notes with surprise the omission of all reference to Bethe and Bacher's report in the *Reviews of Modern Physics*.

B. S. MADHAVA RAO.

L'espace Hermitien Quantique. By J. Pacotle (*Actualités Scientifiques et Industrielles*, Hermann et Cie, Paris, No. 635).

This small brochure of about 60 pages is a semi-mathematical, and semi-philosophical introduction to the geometrical foundations of quantum mechanics. The three chapters in the book might be roughly described as, respectively, mathematical, physical, and philosophical in outlook.

The mathematical introduction to the notion of Hilbert space—the Hermitian quantum space as the author calls it—is based on the abstract or axiomatic method, but it may be pointed out that the treatment does not appear to be perfectly rigorous. Thus while the axioms of linearity, and of the scalar product are fully dealt with, very little is mentioned about the dimensionality axiom. As is well known, in the case of an infinite number of dimensions, it becomes necessary to characterise the space by two further axioms of separability and completeness. There is no discussion of these axioms in the book.

In the second chapter, which is physico-mathematical, there will be found a number of new and refreshing ways of looking at old things—as for example, the notions of "axes of probability," "Hermitian derivative," and "quantum derivative".

The last chapter deals with what the author calls "quantum ultra phenomena", *i.e.*, *phenomena* not of the type which can be actually verified experimentally, but those which can be subjected to "*Gedanken experimente*". The world of ultra-phenomena is also contrasted with the noumenal world—thus the Descartes Universe of atoms would be of the latter type, while the structure of the Universe by chemical atoms is an ultra-phenomenon. The chapter contains a number of interesting and illuminating remarks, but one can hardly refrain from asking the question as to where all this speculation leads us to.

This is a thought-provoking book which one is sure to read with great interest.

B. S. MADHAVA RAO.

Réunion International de Physique-Chimie-Biologie: Congrès du Palais de la Découverte, Paris, October 1937. I. Physique Générale. (*Actualités Scientifiques et Industrielles*, Hermann et Cie, Paris, No. 731), 1938. Pp. viii + 80. Price 25 *fr.*

This is a report of the papers contributed to the discussions of the International Union of Physics, Chemistry and Biology held at the Palace of Discovery in the Paris Exhibition in October 1937. We have contributions from P. Debye and F. Simon on the theory and practice of producing extremely low temperatures, Wiersma on the conductivity and supra conductivity of pure metals, Sir C. V. Raman on the Optics of Colloids and on Hypersonic Waves in Liquids, M. Polanyi on the Deformation of Solids and Balth van der Pol on Relaxation Oscillations and Demultiplication of Frequency. Short reports of the remarks made by others during the discussion are also included. The papers contributed are of the nature of rather short summaries and in the case of Sir C. V. Raman's contributions we have only the titles of the topics mentioned. We do not also find extensive bibliographies as is but natural. But it is a rare opportunity provided by the Publishers for a large circle of readers to have their ideas on modern developments in physics oriented by persuing these summaries due to master-minds and recognized workers in the several fields. Though any detailed information is not to be sought for, the present report will serve admirably as a guide to those topics which are now engaging the attention of the chief workers in science. We could only wish that each contribution was a little more extensive.

One other point which strikes us is the fact that there are numerous printer's and other errors in those contributions which are not in French, possibly on account of mistakes due to the shorthand reporter. But one does not lay any stress on such a minor imperfection when one is provided with such a sumptuous fare. We can only desire that as many as possible may become acquainted with the contents of this pamphlet.

T. S. S.

College Physics. By John A. Eldridge. (John Wiley & Sons, Inc. New York; Chapman & Hall, Ltd., London), 1937. Pp. 616. Price 18*sh.* 6*d.*

The book is written by a master in the art of teaching and as such it will be welcomed by all physics teachers whose aim in the classes is to make the subject interesting and impart to the students a substantial grasp of the physical principles involved in the various phenomena. Physics that only describes and does not explain is no physics.

The title of the book is rather misleading. It is definitely not a book written more or less in the conventional style giving a mathematical treatment of the subject, and which can be used as a text-book for the Intermediate and undergraduate courses of any University, a book in short, with which a student may learn to pass an examination in physics, without necessarily liking the subject. It is written in such a style and manner that it appeals to the student who takes an interest in the subject and to whom passing an examination is but an incident.

The approach to each subject is quite modern, the notion of electrons and protons being introduced almost at once. Modern aspects of the subject are fully dealt with in an easy and comprehensible way. The language is of the popular type without in anyway sacrificing scientific accuracy.

The tables give practical and useful information. The illustrations are numerous and self-explanatory. We warmly recommend the book to every college library.

A. S. G.

A Text-Book of Heat (Part I). By H. S. Allen and R. S. Maxwell. (Macmillan & Co., Ltd., London), 1939. Pp. viii + 527. Price 10*sh.*

The book consists of 23 chapters covering the usual topics, *i.e.*, Temperature, Expansion, Calorimetry, Change of State, Atomic and Molecular Theory, Gases, Conductivity, Radiation, the Earth's Atmosphere, Water Vapour in the Atmosphere, Thermal Units and Dimensions. The First Part "is mainly descriptive and experimental, and although the notation of the calculus is introduced, the mathematical treatment has been kept as simple as possible".

The authors have adopted the historical method, from the first speculations of the early philosophers on the nature of heat, to the more recent ideas connected with the quantum theory. The method not only possesses an educational value, but it also corresponds with the logical development of the principles involved.

Part I includes a number of biographical notes, arranged in alphabetical order. The legend that Galileo made the discovery of the isochronism of the pendulum by observing the swinging of a lamp in the Cathedral of Pisa is duly recorded as a fact.

The worked examples are well chosen. They clearly explain the principles involved. The questions and examples at the end of each chapter are taken from British Universities examinations. They are numerous and well worded, though, as usual with such questions, they smell too much of the school room. The figures are neat and clear.

A successful attempt is made at various places to bring the matter explained in the book in touch with ordinary life. See for instance the illustrations and applications of expansion (p. 86), some applications of calorimetry (p. 184), commercial applications of solids and liquids at low temperatures (p. 381), etc.

The two chapters (XXI and XXII) devoted to the discussion of the phenomena connected with the earth's atmosphere are most welcome.

On the whole, the book under review seems to be the work of able and painstaking teachers, excellently produced by the publishers, and fairly priced at 10 shillings. Not many Indian students will be able to buy it. But several copies ought to enter every College where Physics is taught.

D. FERROLI, S.J.

Systematic Qualitative Organic Analysis. By H. Middleton. First Edition. (Edward Arnold & Co., London), 1939. Pp. 273. Price 8*sh.* 6*d.* net.

The book deals with the methods that are to be employed in the identification

of the more common organic compounds. "The Systematic Schemes of Analysis" described in the book are based on the actual methods of investigation carried out by the author on more than six hundred compounds. The derivatives mentioned have all been prepared by the author and are found to be the most suitable for quick and correct identification. The author has also borne in mind the cost of chemicals to be employed in preparing the derivatives. Though the book deals with the identification of simple organic substances, the author briefly describes the methods of separation from mixtures of organic compounds. General and sometimes specific methods for the preparation of the derivatives have been given and this avoids the necessity of the student referring frequently to other books on preparation of organic compounds. The book will serve as a useful guide to students of the B.Sc. (Honours) class of Indian universities. H. S. J.

A Guide to Chemical Laboratory Practice for Beginners. By H. Bassett. (Macmillan & Co., Ltd., London), 1938. Pp. 94. Price 2/6.

This small book containing the most elementary but yet fundamental matters and operations will be very useful to a beginner entering a practical class in Chemistry. It gives very useful advice to the student in regard to the manner of handling apparatus and also regarding practical operations.

M. SESHAIYENGAR.

Intermediate Readings in Chemical and Technical German. Edited by John Theodore Fotos and R. Norris Shreve. (John Wiley & Sons, Inc., New York; and Chapman & Hall, Ltd., London), 1938. Pp. 42 + 219. Price 9*sh.* 6*d.*

A knowledge of German has always been considered indispensable to the Chemist engaged in routine or research work. Hence any number of books have been written with the good intention of helping the beginner on his way. The above book is one such and is different from the generality in that, original literature has been extracted for the purpose of familiarising the student with the language.

The authors of the above book are professors of the Purdue University, the former of Modern Languages and the latter of Chemical Engineering. They have pooled their knowledge and experience in teaching in an effort to give an easy and instructive course needed by the scientist in general and the chemist in particular. Naturally their selection of material is confined to the field of chemistry. The method of instruction follows the usual form of notes on grammar and then readings in German. It would have been much better for the student if the method followed was one in which easy reading lessons are interspersed with grammatical notes on points raised in sections already read. The purpose of books, like the above, must not be to usurp the place of a regular course of instruction in grammar but to impart as good a working knowledge of it as possible.

"The selections in this series have been made to illustrate not only variety of subject-matter, but also variation in style and progressive difficulty in reading. This book is to be used in any class that has had elementary instruction in German grammar." It would have been more effective had the natural method of teaching a language been followed—especially in the case of students who have already an elementary knowledge of grammar—by explaining the difficult words and grammatical points in simple German as has been done in the excellent little book entitled *Deutschkurs für Ausländer* and published by the Deutsche Akademie, München.

The book is well printed in clear type. It can be recommended to the student of science who has to learn the language to keep himself in touch with the literature published in the German language.

N. G. C.

Travaux Pratiques de Physique, II. Optique, Électricité. By Maurice Prost. (*Actualités Scientifiques et Industrielles*, No. 731, Hermann et Cie, Paris), 1938. Pp. 110. Price 21*fr.*

This is a laboratory manual in Optics and Electricity for medical students. In Optics, spherical mirrors, spherical and cylindrical lenses, the microscope, the spectrometer, the spectroscope, the Bunsen photometer, interference (by the split lens method), the polariscope and saccharimeters (Laurent's and Soleil's) are dealt with. In Electricity we have 'J' by the electrical method, the voltameter, the Post Office Box and the Meter Bridge, the potentiometer, the ballistic galvanometer, alternating currents, and the

triode valve described. There is also a section on the absorption of β-rays. Deviations from the treatment usual in English books are found in the notation, in the lens formula $\left(\text{given as}\frac{1}{u}-\frac{1}{v}=\frac{1}{f}\right)$ and in the description of some of the instruments. It is also rather peculiar that Wheatstone's name is consistently spelt Wheastone. A very refreshing feature is the discussion of possible errors, accompanying the description of each experiment. This will give a better sense of balance to students who, as the present writer knows to his discomfiture, have a knack of displaying unwarranted decimal figures in the results of rough experiments and equally persistently omitting necessary decimals in more accurate determinations. Our B.Sc. students will have a fresh light thrown on their studies if the methods of this book are followed as an interesting variation from the usual routine.

T. S. S.

Studies in Philosophy. (*Actualités Scientifiques et Industrielles*, Hermann et Cie, Paris) (790), 1930, pp. 54; (809), 1939, pp. 149; (813), 1939, pp. 87.

The publications issued under the general heading *Actualités Scientifiques et Industrielles* afford considerable striking evidence of sustained intellectual endeavour, and in the Vol. No. 790 under notice, Emile Brehier sets forth and discusses some of the significant problems of ancient Greek Thought. After a summing up of certain considerations and conclusions general in character and indicative of the main tendencies, Pre-Socratic Thought is examined. The contribution made by Plato, Socrates and Aristotle is discussed. The volume concludes with a section on "Neo-Platonism".

(2) Vol. No. 809 contains a fairly full survey of the problems connected with Psycho-Analysis by Charles Baudouin. Psycho-Analytic Theory and Practice, the technique of Freud and others have all come to stay, and the part played by them in modern psychology is prominent sometimes even to an aggressive degree. The section on "Psychotherapy and Mental Hygiene" deserves particular mention. "In memoriam" touching the demise of Alfred Adler (1870–1937) is a fitting tribute to the memory of a powerful personality in the province of psychoanalysis. During the time of the world-War, 1914–18, war-psychoses, and war-neurosis contributed evidence of considerable importance in support of psychoanalytical theories. To-day when War again is in progress the problem of psychoanalysis gains additional significance. War-Lords, War-Mongers, by whatever name one may choose to call them, must reveal abnormal mental and physical characteristics and psychoanalysis must be indeed a vain and arid pursuit if by a successful application of its methods abnormalities of mind are not got rid of. Absence of mental hygiene is responsible for all destructive activities like Wars. The Bibliography which contains names of 44 volumes and 231 articles is needlessly exhaustive. It must be obvious not all works and articles here listed can be of the same importance or quality. One would have preferred a limited, selective Bibliography.

(3) Vol. No. 813 by le P.M.-D. Chenu, O.P., is devoted to a study of Mediæval Philosophy. The section on Arab Philosophy is a distinctive study. Trends and tendencies of the 12th, 13th, 14th and 15th centuries have been studied in a matter-of-fact manner. By no means original, the studies are useful.

R. Naga Raja Sarma.

Grundriss der Histophysiologie. By E. Ries. (Akademische Verlagsgesellschaft M.B.H., Leipzig), 1938. Pp. 413. Price 26 R.M.

For a long time cytological studies have been confined mainly to the nucleus. As a matter of fact, it occupied so large a part of our attention in the past that other parts of the cell, no less vital to a proper understanding of the Cellular Dynamics, were neglected or relegated to a place of secondary importance. Histology, which forms an indispensable part of zoological studies, has been taught to generations of pupils as a disciplinary course preceding Cytology, and no attempt has been made to probe deeper into the mysteries of the cell.

The antiquated methods of Cytology and of Histology have certainly outlived their usefulness, and the old-fashioned courses now only serve to train the new generation of pupils in microscopy and in microscopic anatomy. Beyond this, they have little to commend themselves. In recent years, however, more fascinating fields and pastures new have been opened out to us by Histophysiology or Histochemistry.

Not very long ago the tissue culture technique gave a new lease of life to Cytology and the recent work on Mitochondria and Golgi bodies has shown us that the nucleus is not the only box of Pandora within the cell, the cytoplasmic constituents being equally elusive and interesting. It must, however, be confessed that cytological and histological studies, even at the present time, are preponderatingly static in their method of approach and treatment. The functional phases of the cell, either in the lower organisms or in the animal tissues, have seldom been investigated with the same fervour or keenness as problems of Cytomorphology. It is no doubt true that, now and then, attempts were made to switch Cytology and Histology on to new rails but without any spectacular success.

During the last 20 years or so, Cytology has taken a new turn. Methods of vital staining and histochemistry have been tried and adopted as routine methods in some of the venturesome centres of zoological research in Europe. Judging from the results of the past few years, it is possible to hazard the opinion that these new branches of Cytology have a great future before them. In the years to come, the zoologist is bound to turn to the histo-physiological methods for the elucidation of many of the obscure points in Animal Morphology, and histochemical methods will be increasingly employed in zoological laboratories.

Not very long ago, we had an excellent manual on histochemistry by Lison and the present volume by E. Ries will be welcomed by all students of Cytology. E. Ries has provided us with a masterly survey of the whole field of Cytology and of the achievements of the past few decades. Even those who are actively engaged in this field of study will find the contents of this book informative and thought-provoking. Both the author and the publishers are to be congratulated for bringing out this useful book on this subject.

A. B. MISRA.

The Fundamental Theory of Arc Convertors. By H. Rissik. (Chapman & Hall, Ltd., London), 1939. Pp. 304; figs. 79. Price 18*sh.*

This book forms the eighth volume of *A Series of Monographs on Electrical Engineering* under the editorship of Mr. H. P. Young. The present volume on arc convertors from the pen of Mr. Rissik is very welcome, as he has contributed much to the English technical press on this all-important subject, including a volume on mercury-arc current convertors.

The mercury arc rectifier has undergone some very progressive and striking developments during the past thirty-seven years, since it was first devised by Cooper-Hewitt. The increasing use of this type of rectifier for supplying the D.C. anode power of valves in high power Broadcasting Stations, in Electric Traction, high currents in Electrolytic work, really needed a book of this kind for the specialist, where the design aspect has been kept in the foreground.

The book contains twelve chapters, divided into three parts: Part I deals with the normal rectifier circuits, Part II with that of the now increasingly popular 'Grid controlled rectifier', and Part III with the Invertor or Cycloconvertor. The text of Part I follows a small 'Introduction' of 11 pages being a survey of the practical applications, classification and historical development of convertors.

It is very welcome to find considerable data on the interrelationships of the different circuit quantities on the D.C. and A.C. sides of the apparatus. Perhaps, by far the most interesting part of the book is Part III where the latest information on 'Invertor' —(the apparatus for converting D.C. to A.C.)—is given. It is expected that this subject will have a great future in connection with the High Voltage D.C. electric power transmission over long distances—one of the dreams of the Power Transmission Engineer. The last two chapters of the book, in particular, contain valuable information on Cycloconvertor or the static frequency and phase changer, which is a highly complex outcome of the arc-convertor.

The Bibliography at the end of the book containing no less than 209 references, adds to the utility of the book.

It is somewhat disappointing to find that no good explanation or discussion of the arc-back problem is given. The general tone of the book is distinctly mathematical and theoretical, than practical. The book would have found favour with a wider range of Electrical Engineers had it been less mathematical and dealt more with practical applications and troubles, etc., in a descriptive manner.

The book should find a place on the shelf

of the reference library or the design office rather than in the laboratory, power or broadcasting station. It is recommended for the advanced student or an electrical engineer who wants a thorough understanding of the theoretical principles underlying the design and operation of the different types of arc convertors in vogue to-day. The general get-up of the book is excellent and the price reasonable.

V. V. L. R.

Organic Synthesis, Vol. XIX. By John R. Johnson. (John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London), 1939. Pp. 105. Price 8*sh.* 6*d.*

With the publication of this volume which describes thirty more preparations, the recording of detailed directions for 548 organic chemical reagents is completed in this series started in 1921. The following are some of the examples which may interest a general student in this volume:—acetyl glycine, dichloracetic acid, *p*-dinitro-benzene, *iodo*-benzene, *o*-phenylene-diamine, the larger number being mostly of the more uncommon type. The details for the preparations are as usual very elaborate but considering the larger units used in these preparations, greater care will still need to be exercised by the less experienced to avoid risk of fire and explosion always associated with organic work.

B. S. R.

The Earliest Men. *Huxley Memorial Lecture,* 1939. By J. Reid Moir. (Macmillan & Co., Ltd., London). Pp. 32.

This little book is a worthy tribute to the significant work of the great scientist, brilliant in achievements and unrivalled in their exposition, whose memory is intended to be perpetuated by the inauguration of Memorial Lectures, by the Governing Body of the Imperial College of Science and Technology, 1925, following the celebration of the Centenary of Huxley's birth.

The book is devoted to expounding the evidence recently accumulated in order to furnish an answer to the question, "Where then must we look for primæval man? Was the oldest *Homo sapiens* Pliocene, or Miocene, or yet more ancient?" which Huxley had raised in his book, *Man's Place in Nature.* Palæontologists and archæologists are now agreed in thinking that man existed in the Pliocene period and they are satisfied that the material at their disposal warrants such a conclusion. Whether his antiquity extends into the Miocene is a proposition on which only tentative conclusions can be reached, in view of the differences of opinion on the Eoliths in the Aurillic series discovered in the gravel deposits of Upper Miocene Age in the Cautal, France. In the case of stone implements which form in the majority of cases the sole survivals of man's past history, there is bound to be room for the opinion that they may have been of natural origin or that they were shaped and used by intelligent beings. To the third question of Huxley, whether man existed in still older periods, no answer can be attempted at present.

The author also discusses in his address the origin and antiquity of the modern type of man, with reference to the discovery of portions of a human skull of this type in the 100-foot terrace of the Thames. "To greatly extend our conceptions of man's antiquity appears a necessity" and taking into account all the available evidence, it will extend, perhaps, as far back as two million years.

The subject of man's origin and his antiquity must always exercise a strange fascination on the imagination of modern man and this story is presented in the book with all the charms of literary grace and scientific judiciousness.

Colon Classification. By S. R. Ranganathan. Revised Edition. (The Madras Library Association, Madras; and Edward Goldston, Ltd., London), 1939.

Rao Saheb S. R. Ranganathan has done a great service by publishing a revised edition of his *Colon Classification,* an original work, which, while assimilating all that is best in the standard schemes in use in Western countries, improves upon them by constructing a schedule of classification suited to India with the advice of authorities on the several subjects like Science, Linguistics, Religion and Philosophy. This is amply illustrated by the attention paid in the scheme to Hindu Religion, Indian Philosophy, Spiritual Experience and Mysticism, Sanskrit and South Indian Languages like Tamil.

The first three parts and numerous examples given in Part IV help the clear grasp

of the principles of Colon Classification and its application to advantage to the vast stores of books on Indian civilization, philosophy and culture, especially of the South.

K. KASTHURI RANGACHAR.

Plant Breeding Technique in Recent Years. By R. H. Richharia. (The Bangalore Press, Bangalore City), 1939. Pp. 73. Price Rs. 2-8.

The publication of this book has removed the long-felt want of amateur plant breeders and persons interested in the science of plant breeding, who have neither the necessary background for understanding the subject nor the proper opportunities to learn the modern technique. It will also be of great use to students of Agriculture and Botany.

The author has divided the book into fourteen chapters describing the different aspects of plant breeding and vividly putting forth the importance of cytological investigations in understanding the problems of plant breeding and genetics, especially by the non-Mendelian methods. Chapters on polyploidy, haploidy, decapitation and effect of temperatures, chemicals and radiations are particularly intersting.

Numerous diagrams and illustrations make the reading of the book more interesting. The get-up of the book and printing are excellent.

R. J. K.

From J. J. to G. P.

Theory and Practice of Electron Diffraction. By G. P. Thomson and W. Cochrane. (Macmillan & Co., Ltd., London), 1939. Pp. xii + 334. Price 18*sh.*

SIR J. J. THOMSON, while describing the discovery of the electron writes in his book *Recollections and Reflections*: "At first there were very few who believed in the existence of these bodies smaller than atoms. I was even told long afterwards by a distinguished physicist who had been present at my lecture at the Royal Institution that he thought I had been 'pulling their legs'." Professor G. P. Thomson when he first published in 1927, photographs obtained by sending a beam of homogeneous cathode rays through a very thin film of collodion, could also have been accused of leg pulling. The average physicist then was either unaware of de Broglie's theory or he did not suspect that there would be such a strong coupling between the probability waves and atoms, which would permit them to form diffraction patterns of appreciable intensity. The fundamentals on which this significant achievement has been based are now recounted in this book.

The first chapter deals with the fundamental properties of wave motion and de Broglie's wavemechanics. The theory has been written from the point of view of an experimental physicist, and the physical significance of various mathematical operations has been cleverly pointed out. Thus about the Huygens' construction the authors write that it implies nothing not already given by geometrical optics. They define group velocity as the velocity with which a peculiarity associated with the group, such as a maximum of amplitude will advance.

De Broglie started from the idea that Einstein's equation $E = h\nu$ represents a fundamental relation between energy and frequency. By the theory of relativity a particle of resting mass m_0 has associated with it energy m_0c^2, and should therefore have an inherent frequency $\nu_0 = m_0c^2/h$. De Broglie regarded this as the frequency of a pulsation in the space surrounding the particle. The wave velocity is $V = c^2/u$ and the corresponding wave-length is $\lambda = h/mu$. De Broglie's idea that the waves act as a guide for the particles and determine their motion necessitates that the ordinary Newtonian mechanics, or rather their relativistic generalisation should be replaced by laws which involve the conception of waves. When experiments are carried out to verify de Broglie's law, it would appear that the theory holds up to as high as a million volts, to better than 5 per cent. This result is important because the theory given by de Broglie is incomplete as it takes no account of the spin of the electron; but the terms involving spin should be expected to become important for speeds near the velocity of light. Thus the equation

$$\nabla^2\psi + \frac{8\pi^2 m_0}{h^2}(E - F)\psi = 0$$

is incomplete and it is therefore interesting that it still gives the right value for the wave-length.

The readers are next treated to an account of Ewald's reciprocal lattice, and

how the pattern obtained on a distant screen will be the projection of the points of the reciprocal lattice lying on Ewald's sphere. It is only in exceptional cases that a point will lie actually on the sphere, but the rigorous conditions are relaxed in various ways. The wave-length of the electrons will not be exactly fixed, the real crystals have imperfections, and these imperfections assume enormous importance as the angles of diffraction are very small. This enables the authors to explain such phenomena as the Kikuchi patterns, the so-called forbidden spectra and the subsidiary diffraction maxima observed by Finch and Wilman.

The intensity of the diffracted beams depends not on the atom form factor only but also on the structure factor. The most important point that appears is the very large values of the scattering of electronic waves as compared with X-rays.

There are three chapters which will be of great use to experimental physicists interested in electron diffraction. The effect of the refractive index of the specimen is described and it is pointed out that such an effect should be considered only in the case of reflection experiments from reasonably smooth surfaces. The formation of Kikuchi lines, their changes of intensity and the envelopes of Kikuchi lines have received their due share. The effect of temperature and the size of the crystals on the dimensions of the lattice has been pointed out. But the description of the principal types of diffraction patterns observed and the way they should be interpreted is so important that a beginner would be well advised to master it before he starts taking electron diffraction pictures. It is interesting to note that the minimum thickness to give a detectable pattern with 30,000 volts electrons is of the order of 10–12Å; and it is this property which makes the electrons indispensable for surface investigations. The authors point out that part of the electron diffraction technique is ordinary vacuum practice. They also describe the various types of electron diffraction cameras which have been evolved, how the specimens should be prepared, and photographic patterns measured.

In a limited number of special problems, a large proportion of the information has been obtained by the application of electron diffraction methods. The problems thus treated are the measurement of inner potential, the study of the growth of crystals, the nature of oxides and the polished layer and the structure of oils, greases and lubricants. There is also a wider field in which the method of electron diffraction can be used. The authors after describing the technique and the theory of electron diffraction by gas molecules point out that the interpretation of electron diffraction patterns from gas molecules is not so straightforward as in the case of crystalline solids. Generally speaking, a trial and error method must be adopted; a molecular model of definite dimensions has to be found such that the calculated distribution of intensity agrees with the experimental results. This is illustrated by applying the method to a benzene molecule, and pointing out that in such a case it is possible to infer that the C – C bond 'resonates' about equally between a single bond and a double bond. Lastly the slow electrons have an advantage over fast electrons in that they are more sensitive to absorbed gas.

The book closes with a discussion of the present limitations of the theory. Thus a full description is given of Bethe's dynamical treatment of the diffraction of electrons. And although the dynamical theory is based on sounder foundations than the kinematical, it has not been able to claim more successes than its rival—the kinematical theory—which has the advantage of simplicity. Darwin's version of the theory of the spinning electron is given and it has been pointed out that the detection of any effect due to magnetic moment or polarisation is not an easy matter. All theoretical physicists except Mott find no appreciable effects due to polarisation, while Mott finds that nuclear scattering ought to produce an appreciable asymmetry of the scattered electron beam if certain conditions are fulfilled. The experimental results, however, definitely prove that Mott's theory is not correct, as applied to the scattering of electrons by thin films of gold.

The treatment of the subject is throughout lucid and *anschaulich*. The book combines the unique qualities of simplicity and authority and as such is likely to prove itself the bible of electron-diffractionists or should we say interfractionists. But could we expect anything else from a book that comes straight from the pen of Prof. G. P. who is the world-authority on the subject of electron diffraction?

K. R. Dixit.

Spectroscopy and Its Applications

Proceedings of the Sixth Summer Conference on Spectroscopy and Its Applications, 1938. Edited by G. R. Harrison. (Massachusetts Institute of Technology Press; Chapman & Hall, Ltd., London), 1939. Pp. vii + 172 (10" × 7·5"). Price 15*sh.*

APPLIED Spectroscopy is in a period of active growth. Astronomers, biologists, chemists, geologists, metallurgists, physicians, physicists, and industrialists of many kinds find the techniques of spectroscopy of great advantage, and are taking to it at an increasingly rapid rate. Thus H. R. Kreider of the American Medical Association Laboratory (p. 53) says: "We have practically omitted the chemical qualitative analysis except as a test: .... exact qualitative analysis of from 10 to 15 materials may be made in an hour, and a permanent record of the analysis obtained. This permanency of records is extremely important in the event of law suits, which play a rather important role in the work". Further, notwithstanding certain limitations, spectral analysis has already displaced gravimetric analysis in many instances of routine or control work, opened new fields in science and industry, and gives promise of going still further. It is interesting to recall in this connection that much of this confidence and spread in practical applications is largely due to our theoretical understanding of the principles of spectral emission, based on the work of Bohr and a host of other physicists. One has got only to add to these techniques those of the molecular spectra of the Raman type, which are now equally accessible in an analytical laboratory, to realise the future possibilities.

Under the ægis of the Massachusetts Institute of Technology, annual Summer Conferences have been held on spectroscopy and its applications, commencing from 1932. The volume under review contains, though in an abbreviated form, the 31 papers presented during the Sixth Conference held in July 1938. The subjects covered comprise a very wide range, from descriptions of specific applications as in the investigations of vitamins, enzymes, rare earths in plants, minerals, criminal investigations, etc, to discussions of the methods of exciting spectra, *e.g.*, 'characteristics of spectroscopic light sources' (p. 54), their recording, *e.g.*, use of grating spectroscopes (pp. 71, 80) and their evaluation, *e.g.*, 'a high speed method of absorption spectrophotometry' (p. 91). This last paper describes an apparatus, developed at the M.I.T., which permits density measurements to be made at the rate of 10 or more per second, using a combination of concave grating monochromator, amplification of photo-electric currents with an electron multiplier, and recording with a cathode-ray oscillograph and motion-picture film. There is also the desirable leaven of papers of theoretical interest, *e.g.*, 'photo-chemistry of visual spectrum' (p. 134), and 'the photographic latent image from the standpoint of the modern theory of solids' (p. 157).

Though the papers are presented in an abbreviated form, they are clearly illustrated and include references to original papers. The get-up of the volume leaves nothing to be desired.

M. A. G. RAU.

Evolution of the Human Brain

THE size of the Primate brain ranges from about 3 gms. in Tarsius to as much as 2,000 gms. in Man. Its basal structural pattern, however, remains the same throughout the Order and in Old World Primates the interrelation of surface to weight of the cerebral hemisphere and of its parts is more or less constant. The difference in brain-size between an Old World monkey (*e.g.*, a rhesus monkey) and a gorilla is far greater relatively than the difference in size between the gorilla and Man. Yet few, if any, significant and measurable difference exist between the intelligence of the monkey and gorilla, whereas an enormous gap exists between the intelligence of Man and that of any other Primate. The anatomical evolution of the brain thus hardly parallels the evolution of intelligent behaviour. Experimental study has also indicated that there is relatively little difference in the level of learning ability between an ape and an animal as far removed as a goldfish. Significant advances in the evolution of human intelligence would seem therefore to be related to the development of speech and to the elaboration of a symbolic process.—(S. ZUCKERMAN—British Association for the Advancement of Science, Dundee, 1939—*Journal*, p. 118.)

CENTENARIES

Bree, Robert (1759–1839)

ROBERT BREE, a British physician, was born at Solihull, Warwickshire, in 1759. Having received his education at various places he took his M.D. in 1791. After having served for a short period, he had to return from the profession temporarily in 1793 as a result of an obstinate attack of asthma.

Authority on Asthma

He resumed work next year at Birmingham. In 1797 he published his *Practical enquiry into disordered respiration, distinguishing the species of convulsive asthma, their causes and indications of cure.* This work is said to have embodied experiments in his own case. It soon became a popular book and reached its fifth edition in 1815, in addition to its having been translated into several languages. It is claimed that this book gave a complete account of the disease and laid down some therapeutic rules of universally acknowledged practical value. Bree's specialist knowledge of asthma brought him to the notice of the Duke of Sussex, who induced him to migrate to London.

His other Publications

Bree also published a small tract entitled *Cholera asphyxia* (1832) and a few papers, *e.g., On the use of digitalis in consumption* (1799) and *On painful affections of the side from tumid spleen* (1811). He delivered the Harveian lecture of 1827 and published it later.

His End

It is an irony that this specialist in asthma fell a victim to the disease once again in 1833 and was thus disabled from further work. Eventually he died of the same disease on 6 October 1839.

Thurston, Robert Henry (1839–1903)

ROBERT HENRY THURSTON, an American engineer and educationist, was born in a family of engineers in Providence R.I. 25 October 1839. Having worked in his father's shops for some time, he entered the Broun University and graduated in 1859.

Pioneer in Engineering Education

On the outbreak of the Civil War, Thurston volunteered as a military engineer. Having seen active service from 1861 to 1865, he became assistant professor in the Naval Academy. In the meantime his contributions to the *Journal of the Franklin Institute* had earned such a name for him that he was invited to organise the newly founded Stevens Institute of Technology. His work at this Institute was largely pioneer in character as there were few precedents and guides. He built up this Institute in a bold and striking way from 1871 to 1885. He made laboratory training compulsory and he established the first mechanical laboratory in 1875.

Bobbyology

After a short breakdown in health due to his zeal for work outrunning his physical endurance, Thurston became the Director of the Sibbly College of Mechanical Engineering in the Cornell University. This post he held till his death. During this period the strength of the College rose from 63 to 885. He had the ability to present scientific results with great clearness. He was affectionately known among the undergraduates as "Bobby" and his lectures on steam-engine as "Bobbyology".

His Contributions

He served on many engineering and industrial commissions. He was one of the founders of the American Society of Mechanical Engineers (1880) besides being a member of several other learned bodies. He was a voluminous writer. He published 20 volumes and 300 papers besides contributing to the *Century dictionary* and editing the engineering articles of the *Universal cyclopædia.* His first book *A history of the growth of the steam-engine* came out in 1878 and every succeeding year saw at least one new book of his till his publication of *The animal as a machine and a prime motor, and the laws of energetics in* 1894.

His Influence

In spite of the prolific nature of his writings, it is said that his influence was even greater through his teaching. It is claimed that "Hundreds of engineers who passed under his personal instruction, being touched by his loyalty to scientific truth and his high ideals of life and service and carrying into after-life the inspiration of his example, were the most influential contribution to his profession of this pioneer in the domain of engineering education".

Thurston died suddenly on 25 October 1903.

S. R. Ranganathan.

ASTRONOMICAL NOTES

Planets during November 1939.—Mercury will be an evening star in the early part of the month and on November 8 attains greatest elongation (23° 10'); on November 18 it is stationary and passes inferior conjunction with the Sun on November 28. Venus also will be an evening star; and on November 18 is in conjunction with Mercury, the angular distance between the two planets at the time being only about a degree and a half. Mars continues to be visible near the meridian at about sunset; on November 29 it will be in quadrature with the Sun. The planet is gradually becoming fainter the stellar magnitude being +0·2 at the end of the month. Both Jupiter and Saturn will be on the meridian in the early hours of the night and are favourably situated for observation. The former will be at one of the stationary points of its geocentric orbit on November 25. Uranus which is about 3° south of the fifth magnitude star ζ Arietis will be in opposition to the Sun on November 13. There will be a close conjunction of the planet with the Moon on November 25.

Comets.—Information has been received of the re-discovery of Periodic Comet Tuttle on August 12 by Jeffers and Moore (*U.A.I. Circ.*, 790). The comet was detected very close to its computed position. It is moving in a south-easterly direction and, early in November will be situated in the constellations Sextans and Hydra. It is rapidly approaching the earth and is likely to become bright enough to be seen with some simple optical aid. The Comet is the most interesting member of the Saturn family; and its period is 13·6 years.

Two of the principal meteoric showers will occur in November—the Leonids, November 13–15 and the Andromedes, November 17–27.

Variable Star.—The well-known eclipsing binary Algol (β Persei) is well placed for observation practically throughout the night during the month. The period of light variation is 2·867 days and the range between magnitudes 2·3 and 3·5; the change in light is most easily noticeable about an hour and a half before and after the times of primary minima, one of which will occur at 8 p.m. on November 2. T. P. B.

Magnetic Notes for August and September, 1939

DAILY CHARACTERS.*—The magnetic activity during the months of August and September 1939 was less than that during July 1939. There were 2 days of *moderate* disturbance in each of the two months. August had 2 days of *great* disturbance while September had none. The number of *slightly* disturbed days during the two months were 16 and 17 respectively. *Quiet* days numbered 11 during each of the months of August and September.

During these months the days on which the magnetic conditions were quietest were August 2nd and September 24th. The most disturbed day during August was the 22nd and that in September was the 17th. Of these two days, the intensity of disturbance on August 22nd was much larger than that on September 17th. The table gives the distribution of all days in the two months classified according to the magnetic character of the days.

Dates 1939	Quiet days	Disturbed days		
		Slight	Moderate	Great
August	1, 2, 4–7, 15, 27, 29–31	3, 8–11, 13, 14, 17–21, 24–26, 28	16, 23	12, 22
September	1, 5, 7, 8, 16, 22–24, 27–29	2–4, 6, 10–15, 18–21, 25, 25, 26, 30	9, 17	Nil

Magnetic Storms.—During August 1939, there were three storms (two of great intensity and one moderate). The beginnings of the great disturbances were marked by conspicuous sudden commencements' in the H, D and Z magnetograms of the Alibag Magnetic Observatory. In September, two storms of moderate intensity with gradual beginnings were recorded by the magnetographs. The number of storms recorded during the corresponding months of the year 1938, were three (all moderate) and four (one great and three moderate) respectively.

Other Magnetic Phenomena.—On September 29th, the H, D and Z magnetograms showed a perturbation between $08^h\ 00^m$ and $08^h\ 13^m$ G.M.T. The All-India Radio authorities in Bombay observed an unusual fading of short-wave reception signals from 1–30 p.m. Indian Standard Time, on this day, the fading continuing for a long time. The GMT of beginning of the perturbation referred to corresponds to the time of beginning of the radio fade out.

Monthly Characters.—The characters based on the International scheme of classification give the mean monthly values for August and September as 0·77 and 0·70. The figures for the corresponding months during 1938 are 0·81 and 1·03.

Tambyacha Bungla, Colaba, Bombay 5. M. R. RANGASWAMI. D. L. CHAUDHURI.

* The daily magnetic characters are determined in accordance with the procedure explained in para 1, of "Magnetic Notes for July 1939", in *Curr. Sci.*, **8**, No. 9, p. 434.

The Scope and Limitations of Physical Anthropology*

PHYSICAL Anthropology is the study of Man as an animal. As the physical nature of Man underlies all his cultural activities, Physical Anthropology is the most fundamental among the subdivisions of anthropological science. As contributions to the knowledge of Man are made by numerous departments of science, periodical evaluation and review of specialist data are of importance to keep up the coherence of Physical Anthropology and also to maintain intelligent contact between representatives of the different branches of Anthropology.

Zoological Position of Man

Recent studies in comparative anatomy, embryology and physiology substantiate in general the orthodox view of anthropologists that a common ancestral stock has given rise to Man and the anthropoid apes, but this view requires to be modified in several points of detail on account of the factor of convergence that complicates human phylogenetic problems. "Resemblance is no proof of relationship", but may be due to parallelism in evolution. For example, the simian features of the extinct lemurs of Madagascar have to be attributed to parallelism, and contrary to the common accepted classification, Lemuroidea cannot be regarded as having given rise to the higher primates, as, in early geological times, they showed specialisations which were avoided by the latter. If the palæontological evidence that irreversibility is a general feature of evolutionary development be accepted, it may be inferred that the ancestral stock from which Man came did not have limbs that were specialised for arboreal life. This will lead us to the conclusion that the man-like characters of the gorilla are parallel developments. It however remains true that Man has a simian ancestry, and G. G. Simpson's superfamily, *Hominoidea*, which includes both Man and anthropoid apes is justified. Comparative physiology of *Hominoidea* is also complicated by the effects of parallel developments. Similar blood groups have, according to Zuckerman, arisen independently in Man and anthropoid apes.

Palæontological Evidence of Human Origin

The solution of most of our problems of human phylogeny will, in future, depend on fossil records as they turn up. Such fossil evidence as are now available are meagre, and have been made much of. Some of the primitive Miocene anthropoids of the old world, particularly *Dryopithecus*, show striking resemblance in their dentition to Man. The splitting up of the *Hominoidea* into several genera appears to have happened early in Miocene times. No Pliocene Man is known to us in spite of the evidence offered by stone tools referred to that age. The earliest *Hominidæ* discovered are *Pithecanthropus* and *Sinanthropus*. Taking in to consideration the relatively greater variability of Man, it appears that anthropologists have exaggerated the points of difference between *Pithecanthropus* and *Sinanthropus* and made two genera of them instead of one. While the skull, brain and teeth in *Pithecanthropus* retained primitive simian characters, the limb bones were like those of *Homo*. This is of significance in showing that the differences in limb structure between Man and anthropoid apes are very old, and that the divergence between the two groups must have taken place at a relatively remote period.

Neanderthal Man of later Mousterian date was more specialised than modern Man, who, it seems certain, was derived, not from these extreme Neanderthals, but from more generalised types of earlier date.

The study of endocranial casts is useful but has its own pitfalls. The convolution patterns in Man and anthropoid apes are not correctly impressed on the bones as in the lower animals. Too much emphasis has been laid in the past on the "simian sulcus" in the study of endocranial casts of fossil *Hominids*, but Elliot Smith has shown how misleading this "simian sulcus" can be. According to him, some modern human brains occasionally develop a sulcus which is easily mistaken for the simian sulcus.

In the study of individual skeletons there are considerable difficulties due to our inability to eliminate variations due to differences in habits, diet, etc. Even the determination of sex offers difficulties when only skulls are available for study.

Physical Anthropology of Race

There is considerable overlap in racial characters even among primary races owing to the "reticulate evolution" of Man. Many of the racial characters now adopted are themselves susceptible to environmental influences, which may obscure fundamental similarities. Blood groups are more reliable, but there seems to be no correlation between them and body types. The determination of racial characters of prehistoric peoples from a study of their skeletons is again of uncertain value. The Grimaldi skulls of Europe, for example, were regarded as Negroid, but Elliot Smith was of opinion that they were merely variants of the Mediterranean race. R. A. Fisher has also shown the greater advantages of the study of the living over that of skeletal material.

The Future of Physical Anthropology

With the handicaps inherent in the material, and with the existing technique, it is doubtful if sensational progress will be made in Physical Anthropology. But biometry still holds the key to the understanding of the composition of geographical groups of Man. Physical Anthropology will have to become more of a field science and study Man as he is to-day, attacking such problems as the relation of nutrition to physique, effects on physical types of change of environment, the phenomenon of twinning, the relation of bodily types to mental traits, etc. Human genetics will have to be studied by the anthropological method. Various formulæ have been devised for assessing the nutritional status, but anthropologists will have to determine what the normal physical type is for a given population.

A. Aiyappan.

* Summary of Address by Prof. W. E. Le Gros Clark, F.R.S., President, Section H—Anthropology, British Association for the Advancement of Science, Dundee, 1939.

Practice with Science*

"PRACTICE with Science", the familiar motto, forms the title of the Presidential Address to the Agriculture Section delivered by Sir Thomas Middleton who curiously enough as he himself recalls presided at the very first meeting of this Section held in Dundee, the centre of the present meeting, when the Section was constituted in the year 1912, now fully twenty-seven years ago. Agriculture has during this period passed through strange and diverse vicissitudes, the epoch of the Great War, post-War upheavals, disastrous price slumps and all but stark ruin, despite, as the address points out in contrast, the great advances on the scientific side of agriculture. The address deals with some of the aspects of the farmer's position during these years, most of which are as familiar as they are baffling. One result as far as Great Britain is concerned is the fact that whereas during the decade 1831–40 the land of that country maintained a population of about 17 millions it now provides food for only about 14 millions. Examples are given from farm surveys to show that the above result is due to the unprofitableness of farming in the country. In the forty-eight years preceding 1919 in one of the farms in the survey a loss was incurred only in two years and in neither year was it a large one; in the fifteen years following 1919 there were six years of loss and the returns per acre in the period prior to 1919 were 75 per cent. greater than they were in the fifteen years following. The plight of the American farmer has been much more serious and this notwithstanding the stupendous efforts of that Government to assist farmers in many directions with the help of a 500,000,000 dollar fund placed at the disposal of the Federal Farm Board. In spite too of drastic measures to dispose of surpluses such as the burning of coffee in Brazil and of wheat in the U.S.A., the slaughtering of pigs and cows by thousands in Denmark and Holland, no relief has been in sight. Though much of this distress is due to the disturbance of normal conditions caused by the Great War, the Address calls attention to circumstances peculiar to agriculture which keep agricultural earnings low; one such is referred to as the tendency to treat food as a commodity on a different footing from other commodities on the idea that it belonged to the nation, i.e., the non-agricultural consumer rather than to the land worker who produced it; the farmer's inability to restrict and adjust output to an anticipated fall in the demand is another serious handicap. American figures, indeed, show that while in a group of years of high prices 22·9 million acres were sown, in a low price period the area rose to 26·5 million acres, the price index during the two periods being 96 and 43 respectively. Conditions in the distributive trades are also such that no matter how high prices may rise for the consumer the farmer gets very little of the advantage. Here is an interesting instance: when the 4-lb. loaf cost 5¼*d.* as it did in 1906 the farmer got 53% of the consumer's money, whereas with the 4-lb. loaf costing 8½*d.* as it does now, the farmer gets only 30% of the proceeds and even that only with the assistance of the Government subsidies. British fiscal policy cannot be held responsible for the depression in British agriculture as is often argued because other countries where a different policy prevails are faced with the same situation. Much is due to factors inherent in agriculture and the world has over a long period been fed at less than cost price, assuring that in cost we include a standard and equated remuneration for service. The subsidies and other Exchequer grants now being made to agriculture are to be regarded in this view not as doles but as deferred payments by the nation, which by implication leads to the conclusion that as long as farming continues to be an unprofitable undertaking the producers of food should be helped out by such grants.

The Address next takes up the second part of its theme, i.e., the scientific worker's programme. During the past thirty years scientific research in agriculture has made great progress and the prospects are now better than ever. Sir Thomas recalls that in his first report from Whitehall he had to point out that the State grant for agricultural research was only £380; at the present time the grant from the Development Fund alone amounts to £500,000. Sir Thomas would disclaim any idea of blaming scientific workers for the enormous surpluses of food, though large increases are undoubtedly due to the activities of plant breeders, chemists, pathologists and others. In considering how best the scientific worker can help in the present situation the example of American reaction to the situation as described in the Yearbooks of Agriculture for the last three years is held up for guidance in respect of the development of national resources and the creation of superior life forms, picturesquely called the "Superior Germ Plasm". The experiment stations are to seek means whereby with the same expenditure of time and energy more food may be produced. Reference is made to the hunt for new plants either desirable in themselves or as breeding material for new types, of the 6,000 such new plants got together by Australia, of the expedition to South America to secure new forms of Solanum for potato breeding, and of the new clovers and grasses now being evolved. In Great Britain soil conservation has been carefully attended to but the need for a more intensive study of soils *in situ* and in greater depths in accordance with recent methods is emphasised. Balanced nutrition, both of humans and of domestic animals, is to be looked at as closely interdependent so that an improvement of the forage, and health and quality of the latter may lead to a lowering of the cost of animal food to the farmer and to their

* Summary of Address by Sir Thomas Middleton, K.C.I.E., K.B.E., C.B., D.Sc., LL.D., F.R.S., President of Section M—Agriculture—British Association for the Advancement of Science, Dundee, 1939.

consequent improvement in health. The opening of a special station for the study of several obscure stock diseases, committees for the investigation of virus diseases, the preservation of grass and other fodder crops, the addition to the entomological and mycological staffs, and the assistance to fruit research may be mentioned among further efforts on the scientific side.

Finally, the address deals with the role which British agriculture should play in the event of war, and here Sir Thomas would strongly advocate an agricultural policy that would enable the country to produce more food than it now can. The storage of food materials and the ensuring of imports by keeping the seas open, will by themselves not be sufficient and in spite of superior antisubmarine methods in a protracted war the call on the land would be at least as great as it was in the Great War. Much controversy notwithstanding, grass land will have to be broken up and an even more intensive "speed the plough" campaign will have to be carried out, because compared with 1917 and 1918 the arable area has gone down by 3,900,000 acres which is now all under grass. A change in the method of farming is also necessary, *viz.*, a system which under peace conditions would provide about from 35 to 40 per cent. of the requirements and in an emergency would enable us to rapidly increase it to about 50 per cent., that is to say, a system of temporary grass to replace part of the present permanent grass, as is already in vogue in Scotland. The flexibility of the system which makes it suitable both for peace time as well as for war time, is a great advantage in its favour. Many problems would arise in connection with such a change-over from an old established practice of the country and in addition to enlisting the confidence of the farmer much intensive research at a special central research station will be necessary, which will include economic studies and a dissemination of the results of such studies among the younger folk. Sir Thomas is convinced that the change-over will result not only in a larger output of production, but also improve the prospects of farming. The nation, however, will have to pay and as it is for services rendered in connection with defence the farmer's claim will be quite as legitimate as those of others similarly engaged. The address, it must be stated, was written before the war clouds burst over Europe and now that the dreaded situation has actually arisen, the address gains added significance.

A. K. Y.

Instruments in Science and Industry*

IN the past, although none too frequently, has the invaluable help rendered by the instrument maker attached either to the laboratory or to a commercial firm, been gratefully acknowledged in many scientific publications. The probable soundness of a theory largely depends upon the accuracy of the data discussed, and among the mathematician's first needs are reliable physical facts. The requirements of the present day are rather exacting and to meet them, all observers now demand far more from their apparatus than was formerly possible, but few realise the amount of thought and labour involved in raising the accuracy obtainable from one per cent. to one tenth of one per cent.

"The development of a particular subject has grown largely with the perfection of the instruments used to investigate it. It is in every way a reciprocal process. By means of an instrument certain evidence is obtained; this evidence does not go far enough, and the instrument must be improved to enable further facts to be found. If, for example, the biologist requires to examine small bodies beyond the range of his microscope, he appeals to the physicist to help him, and the appeal is not in vain. Most probably, as the result of the work on his colleague's problem, the physicist developes a technique which will be of service either to him or to a fellow-physicist."

Mr. Whippley has chosen for his presidential address, the fascinating, but rather wide theme of the help that instruments have given during the centuries to the development of science. The histories of the microscope, telescope, and spectroscope are recounted in a brief but very interesting manner. Mr. Whippley then deals with the modern auxiliary devices such as the fine dividing engines, temperature measuring instruments, galvanometer and thermionic valve appliances.

"In preparing the design of an instrument it must never be forgotten that a good design helps production. It always pays to spend time in the drawing office rather than in the workshop. The application of geometric design often reduces the cost of manufacture, and makes a better instrument. The experimentalist, in making up his own instrument, should consider whether he can obtain the same result by a simply designed geometric piece of apparatus, rather than the more elaborate design to which he may be attracted.

"The instrument maker constantly receives incentives to progress from the scientific worker to whom he owes not only suggestions, but many of his new materials. If knowledge is to progress, it is essential that theory and practice advance together. Nowhere is this more true than in the development of scientific instruments."

M. A. G. Rau.

* Summary of the Presidental Address by Dr. Robert I. Whippley, British Association for the Advancement of Science, Dundee, 1939.

SCIENCE NOTES AND NEWS

The Garner Principle of Co-operative Activation.—Certain reactions such as the denaturation of proteins and the dehydration of calcium carbonate hexahydrate take place at abnormally high rates. To explain this phenomenon, Garner (*Nature*, 1939, 144, 287) proposes a mechanism based on co-operative activation of a number of points n on the surface, the activation energy required at each point being E/n, where E is the measured activation energy. F. G. Donnan (*Nature*, 1939, 144, 446) has pointed out the great importance of the principle in the formation of many catalytic phenomena and in the interpretation of the interlinked sets of reactions which are known to occur in the operation of many enzymes and co-enzymes. K. S. G. D.

* * *

The Coconut Palm Beetle.—This familiar coconut pest commonly known as the rhinoceros beetle is one of the most discouraging and distracting features in the cultivation of the coconut tree in many parts of South India where it is more responsible than any other single factor for causing a serious set-back to the young growing tree, leading in the case of neglect to a complete destruction of the tree. It is probably one of the pests regarding which requests for suitable remedies are received most frequently. A considerable amount of study both in respect of its life-history and of remedial methods has been made but it is nevertheless a fact that many lacunæ exist in the former while as regards remedies no satisfactory ones are yet known. On both of these aspects and especially in connection with the life-history of the pest a careful study extending over a long period has been made, the results of which are now published (M. C. Cherian and K. P. Anantanarayanan, *Ind. Jour. Agr. Sci.*, 9, Pt. III). The duration of the egg period, the larval and pupal periods are all subject to considerable variation and are found to be 9 to 17 days, 100 to 180 days, and 24 to 62 days respectively, the period from egg to adult varying from 129 days to 232 days. The adults themselves were found to live for periods up to a maximum of 293 days. It is also brought out that the beetles are active throughout the year although during certain months of the year, *viz.*, March and April, the pest is most active; elsewhere too this is the same experience, the peak of the damage being soon after the first rains begin. Work on remedial methods which of course are more important from a practical view-point has not led to any helpful recommendations; a trial has been made of various baits, none of which was found of any use. We have noted however that a mash made up of a little groundnut oil cake with cow-dung proved remarkably effective as a bait. We find no reference to the spraying with Bordeaux Mixture which was tried as a good repellent in certain Mysore trials. Various other devices which are probably mere "nostrums" but which may have something in them also deserve to be tested out especially in a thorough going investigation of this kind. The growing alongside coconut plants of plantains and of *Euphorbia tirucalli*, the use of common salt, nux vomica leaves and fruit, the oil cakes of some species of Hydnocarpus are mentioned as repellents of this category—inquiries may bring out more—and these deserve a trial. The familiar skewering out with an iron rod with a barbed end apparently holds the field, in the trials reported. A. K. Y.

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Alcohol as Motor Fuel.—Now that a beginning is being made in India in the use of alcohol for mixing with petrol as fuel in motor vehicles, trials conducted elsewhere on the suitability of such mixtures should be both valuable and interesting. The report of an elaborate trial with alcohol used nearly straight and in mixtures of varying proportions with petrol for driving a motor car appears in the *Philippine Agriculturist*, 28, No. 2 (A. L. Teodoro, Fifty thousand kilometres on alcohol as motor fuel). The trials relate to two groups, one comprising the use of nearly straight alcohol (gasoline being only 3% and 5%) and the other comprising mixtures in which the gasoline was 10, 30, 50, 70, 80 and 90 per cent. The car used in the trials was a De Soto De Luxe Sedan (1929 model) which had run on gasoline for four years during which a distance of 10,678 miles had been driven. Slight alterations were made to the car before the trials such as, enlarging the diameter of the high speed metering jet, and of the area of the pump discharge jet; ignition timing was set 5 to 14 degrees ahead of the usual adjustment for gasoline, and idling adjustment was changed according to the kind of alcohol motor fuel used. Details of the behaviour of the engine in respect of starting, acceleration, power, engine wear, corrosion and economy of operation are given in full. Likewise for each one of the fuels used particulars under working conditions and of the number of miles driven are also given, with full numerical data, for all of which reference to the full report is commended. As the result of these trials in which quite 50,000 kilometres were run it is concluded that the car performed very satisfactorily on these alcohol fuels for a period of five years. No difficulty was encountered in starting except when the engine carburetion and ignition systems were faulty and when the driver improperly used the choke. As much power as could be produced with gasoline was obtained with the alcohol fuels. No sticking of the piston valves was noted. The mileage increased as the amount of gasoline increased in the mixture; thus with the nearly straight alcohol fuels the mileage was only from 8·9 to 9·8 miles per gallon, while with the gasoline mixtures the mileage rose to 11·3, 12·7, 14·4, 15·3, 16 and 17·4 as the gasoline percentage rose from 10 to 30, 50, 70, 80

and 90 per cent. respectively. For the proper utilisation of nearly straight alcohol proper adjustment of carburetion and ignition and care in manipulating the parts which control these systems are specially mentioned as requirements. A. K. Y.

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Some Trials of Citrus Budding Methods.—Is it essential in the budding of orange or other citrus seedlings to remove completely from the inside of the bud shield all adhering wood tissue before inserting it in the T-cut of the stock or can it be left on without detriment or with advantage? It is generally believed that the wood tissue should be carefully removed and only the smooth inside of the young bark should be brought into union with the similar tissue of the stock, if good results should be attained. In practice this careful removal is not always easy, it is certainly slow; and the slipping in of the bud shield too is tricky on account of the lack of rigidity in the shield. From a practical point of view therefore one would welcome a correct answer to the above question, based upon accurately conducted experiments. This has been undertaken under the auspices of the Imperial Council of Agricultural Research on the Fruit Research Station, Anantarajapet, Madras Presidency, and the results are now available (K. C. Naik, *Ind. Jour. Agr. Sci.*, Vol. IX, Pt. IV). Along with this question another point for experiment was also taken up, *viz.*, whether the root stock should be lopped off above the union immediately after the insertion of the bud or after the latter has made some growth. The experiments have been laid out with great care for obtaining significant results which have all been statistically studied and interpreted. It was not possible in practice to ensure what would be considered a very material requirement, *viz.*, that the seedlings used as stocks should be of the same age and of the same degree of growth as judged by their girth. From the trials which have now gone on for two years it is concluded (1) the presence of the wood in the bud shield is a distinct advantage; such retention of wood led to a higher percentage of "take" of the buds, the increase ranging from 32 to 36·51 per cent.; (2) the presence or absence of wood has not affected the period taken for the bud break or for the rapid extension of the bud growth; (3) the primary lopping of the root stock at the time of bud insertion has lowered the "take" of buds in some cases but has stimulated an earlier bud break, both in *chinee* oranges and acid limes, the two citrus varieties used in the experiment; (4) delayed primary lopping of the root stock until the bud growth had extended for a length of not less than two inches resulted in a comparatively rapid extension of the bud growth, in the case of *chinee* oranges. It was also found, though this is only of local application, that the months of July to September were the most favourable seasons for budding. It is stated that the results in regard to the retention of wood in the bud are not in accord with the experience of nurserymen in India, among whom the method of careful removal of the wood is the one generally prevalent. It will be useful to inquire and ascertain if there is any special reason for this preference, especially in the light of the above results and also of the greater ease and speed of the method now recommended. A. K. Y.

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Artificial Insemination of Domestic Animals.—Started many years ago and adopted with a considerable measure of success in the breeding of horses in the U.S.A., and in recent years in the breeding of dairy cattle and sheep in Italy and the U.S.S.R., sufficient progress has evidently been made in its adoption in Italy to justify the holding of a session of the National Assembly of Italian Veterinary Surgeons for Artificial Insemination regularly once in two years, which was decided upon at the last session of the Assembly held in Pavia, Italy, during the current year. It was also resolved at the meeting that the Milan Institute for the study of this subject should set up a permanent committee for the encouragement of research in this field. Plans were also considered for converting these biennial assemblies into International Conferences, for the introduction of regular courses of instruction in these methods in the Veterinary Colleges in the kingdom, for its adoption on an extended basis for the raising of both pure and cross-bred sheep of the Karakal breed, and for the opening of special centres suitably equipped for the purpose. More than a quarter of a century ago, on the stud farm at Kunigal in the Mysore State the method was being tried with the costly imported stallions and recently its possibilities in respect of the raising of Merino crosses with Mysore sheep are being looked into. As a means of getting over some of the serious difficulties connected with this problem of sheep improvement the method holds out promise and a study of the Italian methods in this connection deserves to be taken up in India. A. K. Y.

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***Asura* Culture of Chota Nagpur.**—Some of the large number of prehistoric building sites and graveyards scattered all over Chota Nagpur, particularly in the Ranchi and Singhbhum Districts of Bihar, have recently been brought under protection by the Government of India under the Ancient Monuments Preservation Act, according to a press note from Simla.

The sites were first brought to notice by Rai Bahadur Sarat Chandra Roy, who made a preliminary survey and carried out some trial operations. Mr. Roy found that the building sites contained evidence of two or three periods of occupation, ranging from the Neolithic Age to the early Iron Age.

The present-day aboriginal population of Chota Nagpur ascribe the sites to the ancient *Asura* culture. Whether their own ancestors were the authors of this *Asura* culture or whether another race was responsible for this culture, it is difficult to say. It appears probable, however, that the culture of this region is connected, on the one hand with the Copper

Age of North India and on the other, with the Megalithic and Iron Age cultures of South India.

The Government notification is intended to prevent unauthorised excavation on these sites till such time as the Department is able to detail a specialist for such work in Northern India.

* * *

Vegetable Oil for Lamps.—We are glad to report that Mr. D. R. Jogalekar has successfully evolved a lamp which burns on vegetable oils.

As compared with kerosene consuming lamps, he claims a saving of 20 per cent. in cost, while the luminosity attained is of the same order. The utilisation of these vegetable oils as fuel for internal combustion engine, we are told, is receiving the attention of Mr. Jogalekar, whose attention may be invited to the work already in progress in the Alipore Test House, Calcutta, under the auspices of the *Industrial Research Bureau*. It is a matter for great satisfaction that the work has been financed by the Government of Bombay.

* * *

Campaign against Narcotics.—The latest number of the *Bulletin of the Health Organisation of the League of Nations* (Vol. 8, No. 3) contains, among other contributions, a bibliographical report relating to the pharmacodynamic properties of eucodal, dicodide, dilaudide and acedicone. At its session held in May-June 1937, the Advisory Committee on Traffic in Opium and other Dangerous Drugs, discussed the comparative pharmaco-dynamic properties of certain drugs which are being used as substitutes for morphine and decided to ask the secretariat to prepare a memorandum for the information of the Committee. The Health Section accordingly prepared a report which is now published. This brings to light the results of the studies so far made of the anti-spasmodic, analgesic and hypnotic properties of these drugs.

The other contributions in the *Bulletin* are:—Doping: A study of the means employed to raise the level of performance in sport; Rural Dietaries in Europe; and Report on Bread in Several European countries.

* * *

The Government of India have under consideration proposals for making permanent the **Agricultural Meteorology Section** of the Meteorological Department, which is now financed by the *Imperial Council of Agricultural Research*.

The Section is concerned principally with studies relating to the effect of weather on soil and crops and has a number of experiments on hand. It acts as a *liaison* between meteorology and agriculture by helping agricultural workers in setting up farm observatories, by training their assistants deputed to Poona, and by calibrating or repairing their meteorological instruments when sent to Poona. Special attention is being given to officers in charge of the locust, dry-farming, sugarcane and cereal rust research schemes. An important aspect of the *liaison* activity is to discover the types of weather forecasts and warnings that will be most useful to the farmer generally, as for example, heavy or untimely rainfall, cold wave warnings, etc.

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Island Observatories in Indian Seas.—The question of starting pilot balloon observatories in some of the islands in the Indian Seas is under the consideration of the Meteorological Department of the Government of India.

A beginning was made in April this year when steps were taken to open a station in Car Nicobar Island. An officer was also deputed to visit Laccadive Islands to report on the possibilities of starting a pilot balloon observatory at Amini Devi or Minicoy.

The work of marine meteorology is growing every year. The Department held three meetings with ships' officers and ships' and shore Wireless Telegraph officers in Bombay and two with ships' officers in Calcutta last year, at which experiences and views were exchanged on the Department's service to ships.

Storm warnings for the Bay of Bengal and the ports around it are issued from the Meteorological Office at Calcutta and those for the Arabian Sea from the Headquarters office at Poona. The latest information about weather is supplied to shipping at sea by means of wireless weather bulletins issued from coastal radio stations twice daily on ordinary undisturbed days and more frequently on disturbed days.

The chief sources of marine data are wireless messages from ships at sea and extracts from weather logs of ships calling at the principal ports.

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The Photo-Litho Office of the Survey of India, founded in 1889 by Major-General James Waterhouse, I.A., the celebrated authority on photography, who held charge of the map reproduction of the Survey of India, celebrated its Jubilee last month. The Office is situated in Calcutta and it was here that the first postage stamps of India were lithographed in the early fifties.

A press note issued from Simla draws attention to the main activities of this Department of the Survey of India. The Office employs 300 skilled workers and "More than 3,000,000 impressions are pulled in the machines annually and the value of the annual output at office rates is over Rs. 3,00,000.

"Of the original contributions of the Photo-Litho Office towards development of new ideas and modern methods, mention may be made of the direct zinc printing process now known throughout the world as the 'Vandyke Process' which was evolved at this Office and is named after the late Mr. F. R. Vandyke, Manager of its Lithographic Branch, who was responsible for the discovery.

"An experimental section has been instituted in the Office for research on its own account, where original investigations are being continued."

* * *

Progress of Irrigation in India.—According to the annual review of Irrigation in India, just issued, over one-eighth of the total cultivated area in British India—about 32¼ million acres—are annually irrigated by State works alone. The capital outlay on Irrigation and navigation works amounts to Rs. 154 crores, the working expenses to about Rs. 5 crores and the gross revenue to about 14½ crores, with a net return of 6·09 per cent.

275 Irrigation schemes are in operation in British India, of which 70 are of a major description. Nearly a third are classified as productive and the rest, which have been constructed primarily for the protection of tracts with precarious rainfall, as unproductive.

Of the total irrigated area, 12 million acres are in the Punjab. About 86 per cent. of the total area or about 4½ million acres, is under irrigation in Sind. Madras has 7¼ million acres under irrigation and the United Provinces about 4 million acres.

Of the important works, recently completed, mention may be made of the Kattalai Scheme in Madras, which cost over Rs. 37 lakhs and the Haveli Project in the Punjab, since completed at a cost of about Rs. 4½ crores. A Project for impounding the waters of the Tungabhadra is under consideration.

A contour survey in the central and western parts of Bengal is being carried out. Other important works on hand are the Nira Right Bank Canal works in Bombay, the remodelling of the Ganges Canal Branches in the United Provinces and the Quetta Storm water drainage and embankment project in Baluchistan.

* * *

Scientific Expedition to Central Pacific.—Further details regarding the personnel of the Expedition sponsored jointly by the *National Geographic Society* and the *University of Virginia* (*cf.* this *Journal*, 1939, 8, 391) are now available through the courtesy of the *National Geographic Society*. Dr. Charles S. Piggot, well known for his studies on the silt samples from the ocean bottoms, is a member of the expedition. His amazing apparatus for securing samples of mud from the ocean bottom, consists of a cannon which is loaded with a charge of powder and a projectile, which consists of a hollow metal tube ten feet long. "Lowered to the bottom, the cannon goes off automatically. The force of the explosion drives the hollow tube down into the mud. When it is pulled to the surface it contains a cross-section of silt that has been deposited gradually over a period of thousands of years. Studying this cross-section, scientists can reconstruct from it the geological history of the ocean bottom extending back for many ages."

Dr. Maurice Ewing, Professor of Physics, Lehigh University, Bethlehem, Pennsylvania, is another member of the Expedition, who will be engaged in the study of the ocean bottom by means of his ingenious "artificial earthquake" apparatus. The quakes are produced by small "time bombs" which are sunk to the bottom of the sea and exploded automatically by clockwork. "The explosions cause vibration in the sea bottom like those produced by earthquakes. Automatic recording devices are sunk to the bottom at a considerable distance from the bombs. When a bomb explodes, the sound vibrations travel down through the sediment to bed rock, through the rock in a horizontal direction, and up again through the sediment. The vibrations are picked up by microphones in the recording devices, and cause beams of light to vibrate. An automatic movie camera in the recorder photographs the vibrations of the light beam, and the elapsed time between the explosion and the arrival of the sound in the recorder is noted.

"From this record Prof. Ewing can calculate the thickness of the sediment through which the sound vibrations have travelled. He also can determine the type of sediment—how far it has progressed towards hardening into rock—because sound vibrations move more slowly through soft sediments and more rapidly through harder ones."

* * *

Shortite: a new mineral.—The United States Department of the Interior has announced the discovery of a new mineral, officially named "shortite".

Composed of a double carbonate of sodium and calcium, the new mineral was found and identified by J. J. Fahey, a chemist in the American Geological Survey Laboratory. It was discovered as disseminated, well-formed crystals in sections of core from an oil and gas well, drilled in Sweetwater County, Wyoming, at depths of 1,250 to 1,800 feet below the earth's surface. Shortite was named in honour of Dr. M. N. Short, a former geologist of the Survey, who now is Professor of Optical Mineralogy at the University of Arizona.

—(*Chemical Age*, 1939, p. 168.)

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University of Mysore.—The decision of the University of Mysore to institute post-secondary *diploma course in sericulture* from the year 1940, breaks new ground in the matter of textile technical education in India. At present no diploma course in Sericulture under University auspices is given anywhere in this country. The decision of the Mysore University should therefore be regarded as of a pioneering nature. The Mysore State occupies a pre-eminent position in the production of silk in India, and the institution of a regularised course to train specialists, will lead to increased efficiency in the Silk Industry.

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University of Calcutta.—Mr. Kshitischandra Bhattacharyya, M.Sc., has been admitted to the Degree of Doctor of Science in consideration of the thesis entitled "An Examination of the Question of Strain on Mono-cyclic Rings" which was examined by a board consisting of Professor R. Cornubert, Sir Gilbert T. Morgan and Sir W. J. Pope.

* * *

Associateship of the Imperial Dairy Institute.—The question of according formal recognition to the post-graduate course in Animal Husbandry and Dairying given at the **Imperial Dairy Institute, Bangalore**, since 1923, has been under consideration by the Government of India. It has now been decided that those who have in the past satisfactorily completed the course or who may do so in future should be designated as **Associates of the Imperial Dairy Institute.** This title will be denoted by the abbreviation "Assoc.I.D.I.", which the successful post-graduate students will be entitled to affix to their names.

Industrial Notes

Catalogue of Fibre Plant Exhibits.—This publication which has been sponsored by the *Botanical Survey of India*, is a useful bulletin dealing with the fibre plant exhibits, and the usefulness of the volume would have been considerably enhanced if the author had critically appraised the economic value and indicated the extent of availability of these materials. It is earnestly to be hoped that the author will, in his next edition, not only elaborate these points but also avoid the embarrassingly long four-page corrigendum and addendum.

Laboratories of the British Non-Ferrous Metals Research Association, London.—This is a national organization of producers, manufacturers and users of non-ferrous metals established in 1920 for the promotion of scientific knowledge in Industry. The Association owns a subscribing membership of about 300 and administers a total annual income exceeding £30,000 which is partly subsidised by the *Department of Scientific and Industrial Research*. Since 1930, the council has centralised the administrative, technical and information services of the Association in one building in London near Euston Station. Although much of the Association's research has since been gradually transferred to this centre, a certain amount of investigation is still carried on extra-murally, to take advantage of the special facilities obtaining in other laboratories. The centralisation succeeded in stimulating the growth and expansion of the activities of the Association to such an extent that the council in 1937, approved a substantial capital expenditure on additional laboratory accommodation. The new laboratories which were completed in 1939 are described in a profusely illustrated and well got up booklet which also includes information on the Association's organisation and the type of work carried out, for the benefit of its members.

The International Tin Research and Development Council.—The Council was sponsored some seven years ago by the Governments of various tin-producing areas throughout the world, for the purpose of acquiring and disseminating scientific and technical knowledge relating to tin, its alloys and chemical compounds. The researches and other activities of the council are planned to discover and develop new industrial applications of tin, to improve existing products and processes and to assist tin consumers in overcoming their technical difficulties and problems. This project is directed and financed by the united efforts of numerous political entities.

The research work is widely dispersed at several centres, Aberdeen, Berlin, Birmingham, Cambridge, Columbus (Ohio), Delft, The Hague, Liverpool, London, Manchester, Munich, Paris, Sheffield, Swansea and Utrecht.

At the commencement of the year 1939, the council occupied its permanent headquarters in the vicinity of London, which houses the administrative offices, the technical bureau and the library and the metallurgical and chemical laboratory.

The council issues a quarterly journal under the caption *"Tin and Its Uses"*, which is sent free to those who are interested in the subject. The publication contains contributions of interest to the chemical engineering, moulding, sheet metal working, canning and packing industries. In addition to this quarterly, the council issues special bulletins on subjects like electro-tinning, soldering, tin alloys in dental practice, etc. The international collaboration in the field of pure and applied research on tin secured by the council, is one that should be extended to other economic products of the world.

Titanium Oxide as a By-product in the Manufacture of "Alumina-Ferric" from Bauxite.—The residual mud remaining after treatment of Indian bauxite with sulphuric acid in the manufacture of Alumina-Ferric, contains as much as 35–40% TiO_2 and forms a valuable raw material for the extraction of titanium oxide. The process developed my Mr. S. C. Chakravarty, which is an adaptation of that employed in the manufacture of the oxide from ilmenite, is described in a *Bulletin* (No. 15) of the *Industrial Research Bureau* of the Government of India. Mr. Chakravarty has successfully recovered from his pilot plant operations a product containing 98–99% TiO_2, the yield being about 42% on the weight of the mud. The cost is reckoned at Rs. 35 per cwt., the current market rate being about Rs. 56. The oxide is extensively employed as a pigment in paints, in soap-making and in ceramics and as a component of vitrified enamels.

Announcements

Benares Hindu University.—A Prize called Chandulal Chotalal Mehta Prize consisting of the interest on Rs. 5,000 for one year or of books of the like value to be selected by the winner, shall be awarded for the best essay on the subject "The Population and Production in India".

Competitors shall be graduates of the Benares Hindu University of not more than seven years' standing from the date of the graduation.

The essay must be sent to the Registrar, *on or before the fourth Monday in July 1941*. Each essay shall be designated by a motto instead of the writer's name and shall be accompanied by a sealed cover containing the name of the competitor, his university standing, full address and a declaration that the essay is *bona-fide* his own composition.

The Prize shall not be awarded for an

essay which, in the opinion of the Judges, does not show research or originality of treatment.

The Twenty-third Annual Conference of the Indian Economic Association will be held at Allahabad under the auspices of the Allahabad University from the 29th to the 31st December 1939.

Indian Statistical Conference.—The third session of the Indian Statistical Conference will be held in Madras in the first week of January 1940. It has been provisionally arranged that the Conference will be opened by H. E. the Governor of Madras on the 3rd January. On the invitation of the Mysore University, arrangements have also been made for holding a special session in Mysore, possibly on the 6th and 7th January.

In Madras, the work of the Conference will be carried on in active co-operation with the Indian Science Congress as in previous years. Arrangements have been made for joint meetings with the Sections of Mathematics, Physics, Agriculture, and possibly the Section of Medicine and Public Health. There will also be a special session on Economic Statistics.

The Hon. Mr. V. V. Giri, Minister of Labour and Industries, Government of Madras, will preside over a special discussion on "Labour Statistics".

Papers and scientific contributions should be sent so as to reach the Honorary Secretary, Indian Statistical Institute, Statistical Laboratory, Calcutta, before December 15.

We have been informed by the Secretary, Central Board of Irrigation in India, Simla, that with reference to the statement:

"Discussion on these two subjects seems to have lead nowhere"

[referring to (1) the role of reservoirs in River Flood Control, and (2) meandering of rivers] occurring in the review of the Annual Report of the Central Board of Irrigation for the year 1936–37 (this *Journal*, 1939, **8**, 24, col. 2), the study of these problems is a progressive one carried on from year to year in which way valuable data is gradually accumulated and analysed (*cf.* Report for 1937–38, pp. 64 and 93, and 68 and 108).

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We acknowledge with thanks receipt of the following:—

Journal of Agricultural Research," Vol. 59, No. 2.

"Agricultural Gazette of N.S.W.," Vol. 50, No. 9.

"The Philippine Agriculturist," Vol. 28, No. 4.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 30, No. 8.

"Indian Journal of Agricultural Science," Vol. 9, Pt. 4.

"Allahabad Farmer," Vol. 13, No. 5.

"Journal of the Institute of Brewing," Vol. 45, No. 9.

"Journal of the Indian Botanical Society," Vol. 18, No. 2.

"Journal of Chemical Physics," Vol. 7, No. 8.

"Journal of the Indian Chemical Society," Vol. 16, Nos. 7–8.

"Chemical Age," Vol. 41, Nos. 1043–44, 1048–53.

"Comptes Rendus (Doklady)," Vol. 23, Nos. 8 and 9 and Vol. 24, Nos. 1–2.

"Experiment Station Record," Vol. 81, Nos. 1 and 2.

"Indian Forester," Vol. 65, Nos. 9 and 10.

"Transactions of the Faraday Society," Vol. 35, Nos. 220 and 221.

"Genetics," Vol. 24, No. 3.

"Bulletin of Health Organization (League of Nations)," Vol. 8, No. 3.

"Review of Applied Mycology," Vol. 18, Nos. 7 and 8.

"Calcutta Medical Journal," Vol. 36, Nos. 2 and 3.

"Bulletin of the American Meteorological Society," Vol. 20, No. 6.

"Indian Medical Gazette," Vol. 74, Nos. 8 and 9.

"Indian Journal of Medical Research," Memoir No. 31, July 1939.

"Indian Science Abstracts," 1937, Parts I & II.

"Nature," Vol. 144, Nos. 3639–45.

"Canadian Journal of Research," Vol. 17, Nos. 6–8.

"Journal of Research, National Bureau of Standards," Vol. 22, Nos. 3–4.

"Lingnan Science Journal," Vol. 18, No. 3.

"Indian Trade Journal," Vol. 134, Nos. 1730–36 and Vol. 135, No. 1737.

"Electrotechnics," No. 12, August 1939.

"Forschungen und Fortschritte," Vol. 15, No. 22.

"Mathematics Student," Vol. 7, No. 1.

"Scripta Mathematica," Vol. 6, No. 1.

"Journal of the Indian Mathematical Society," Vol. 3, No. 6.

"Journal of the Bombay Natural History Society," Vol. 41, No. 1.

"Occasional Notes (Royal Astronomical Society)," No. 5.

"Indian Journal of Physics," Vol. 13, No. 3.

"Sky," Vol. 3, No. 10.

"Science Forum," Vol. 4, No. 2.

"Indian Journal of Veterinary Science & Animal Husbandry," Vol. 9, Pt. 2.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

September 1939. SECTION A.—M. W. CHIPLONKAR: *Measurements of atmospheric ozone at Bombay.*—The average amount of ozone and its seasonal variation found at Bombay are in general agreement with those to be expected from Dobson's world-wide ozone survey in 1930. There is practically no correlation between the daily value of ozone, and the pressure at ground level. K. S. VENKATARAMAN: *The adiabatic piezo-optic coefficients of water and the alcohols.*—The elasto-optic coefficients calculated for pressure changes at constant temperature and at constant entropy are always higher than the theoretical value given by the Lorentz formula and the difference between that at constant temperature and the theoretical value, which is due to the anisotropy of the polarisation field is considerably smaller in the alcohols than in carbon disulphide or benzene. J. BHIMASENACHAR: *A modified method of using Poiseuille's apparatus.*—The viscosity of glycerin has been measured at different temperatures. S. PARAMASIVAN: *Technique of the painting process in the rock-cut temples at Badami.* S. S. BHATNAGAR, B. PRAKASH AND J. C. MAHESHWARI: *Magnetism and molecular constitution of some manganese compounds.*—The valency states of manganese in some mangano-halides of pyridine, K_2MnCl_6, $AgMnO_4$, and $K_3Mn(CN)_6$, have been studied. K. VENKATESWARALU: *Polarisation of Raman lines in relation to molecular structure: $SOCl_2$, CH_3Cl and BCl_3.*—$SOCl_2$ has a plane structure, and not a pyramidal one as suggested by the results of Cabannes and Rousset. B. SUNDARA RAMA RAO: *Raman effect in relation to crystal structure—I. Calcite and Sodium Nitrate.* B. S. SASTRY: *Note on a type of generalized Laguerre polynomial.* K. S. K. IYENGAR: *A new proof of the formula for the generating function of Laguerre polynomials and other related formulæ.* P. S. SRINIVASAN: *Ultra-violet irradiation of rubber.*—Irradiation with ultra-violet light makes rubber more transparent when dissolved in non-polar solvents and less transparent when dissolved in polar solvents. T. M. K. NEDUNGADI: *Effect of crystal orientation on the Raman spectrum of sodium nitrate.*—Twenty-three different spectrograms have been obtained with a single crystal of sodium nitrate corresponding to different orientations of the crystal relative to the directions of incidence and observation and different states of polarisation of the incident and scattered radiations. K. S. K. IYENGAR: *A new proof of Mehler's formula and other theorems on Hermitian polynomials.* B. S. MADHAVA RAO: *Quantum-mechanical interpretation of a result concerning Hermite polynomials.*

September 1939. SECTION B.—B. N. ACHARYA AND S. C DEVADATTA: *Compounds of Phosphorus in Milk*—I. B. N. ACHARYA AND S. C. DEVADATTA: *Phosphorus, Calcium and Magnesium in Milk.*

Indian Chemical Society:

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1645-39—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the Board of Editors, "Current Science", Bangalore.